

THURSDAY, APRIL 26, 1900.

THE BIRDS OF CELEBES.

The Birds of Celebes and the Neighbouring Islands. By A. B. Meyer and L. W. Wilesworth. Two volumes. Pp. xxxiii, 392 and 590; with 45 plates and 7 maps. (Berlin: R. Friedlander und Sohn, 1898.)

FEW regions of the world approach in interest to the naturalist the wide Archipelago strung upon the equator, between the Asiatic and the Australian continents, both of which claim a share in the broken lands between which Wallace's Line rides the marches. Of all these islands none perhaps have attracted more attention than Celebes, notably on account of its strange configuration, but especially from its central position in the archipelago which has given a remarkable character to its fauna, the affinities of which have banded it from one to the other of the two zoological realms between which it lies. To which of them it will finally appertain must still remain an open question till it has been more fully explored, botanically as well as zoologically. Towards the settling of this question, however, Dr. Meyer, the distinguished Director of the Royal Museum in Dresden, in collaboration with Mr. L. W. Wilesworth, has made a notable contribution in the work under notice, wherein the ornithology of the Celebesian area (as the authors name the main island plus the neighbouring islet groups in its immediate vicinity) is discussed. Both authors have brought special qualifications to their task, for both have large experience as observers in the field, Dr. Meyer having several years' personal knowledge of the area in question. That every care has been taken by them in the preparation of this monograph is testified to by the six years of constant toil which the subject has exacted from them.

The systematic account of the individual species found in the area is prefaced by a valuable introduction of 130 pages, in which the authors give a short biographical note concerning the naturalists and collectors who have worked or written upon the birds of Celebes. This is followed by an account of the seasons and winds (illustrated by two coloured maps) in the East Indian Archipelago, in their relation to the dispersal and distribution of the birds. A section is next devoted to migration in the archipelago, with reference to which the authors remark that "during our studies it has become abundantly evident to us that ornithologists are not generally aware that migration goes on in the East Indies to the great extent it does." They enumerate fifty-four "of the more prominent migratory birds of Celebes," with tables which tend to "prove that each species has its own route or routes of migration." Some of these species come from Norway *via* Siberia, China and the Philippines to North Celebes, and go no further; others hold on their course to New Guinea, Australia and New Zealand; while yet others fly directly from Northern Asia and Japan to the Philippines, North Celebes or the Moluccas, hugging the coast of the Western Pacific. In their return journey the migrants do not appear "always to return in spring by the route pursued in autumn, often apparently being rare or absent in districts through which they pass in

abundance in other seasons," while a few remain and probably breed in their winter quarters. As to the causes of migration, however, the authors afford us no new facts or suggestions tending to bring us nearer the solution of the "mystery of mysteries" of bird life.

A further section of the introduction is devoted to the subject of "variation or modification of structure and plumage" among the birds of Celebes, under the headings of individual and of geographical variation; seasonal changes; sexual differences, and changes depending upon age. Under the last heading the authors provide "some evidence drawn from Celebesian birds that modifications of shape . . . of feathers are caused by the ever-repeated action of mechanical attrition . . . and are ultimately transmitted to offspring," and they take as one of their examples the case of the racket tail feathers of *Prioniturus*. The two middle tail feathers of these birds "are prolonged much beyond the others, and in adult birds the over-reaching portion of these two rectrices is converted into a bare shaft tipped with a spatule of ordinary web." Drawings are given from specimens in the Dresden Museum showing that the feathers come in in the adult birds with the shafts bare, a character which must therefore be congenital and hereditary. According to the authors, the course of events must have been as follows:—the two middle tail feathers becoming (for no specified or known reason) a little longer than the rest, were by attrition on the twigs of trees, walls of their nesting-holes, &c., narrowed at the tips; the friction reacting on their roots resulted in still greater lengthening of the feathers; further attrition resulted in half-formed rackets [why?]; still further continued attrition and further lengthening of the feathers resulted in the "production of other stages up to the most advanced development of the present time"—"a process of ages, more and more advanced results being obtained in successive generations and transmitted by heredity." Their "arguments in proof that these rackets are the inherited effects of attrition" are shortly: (1) that such can easily be formed artificially by scraping; (2) where the shafts are not exposed to attrition they are not bare; (3) rackets do not occur on unexposed feathers sheltered from attrition; (4) rackets are present in birds having no affinity with one another over the most varied positions; (5) remains of the web are often to be found on the shaft of the racket; (6) there appears to be no other means for accounting for their origin—they are not sexual, not useful, and not "recognition markings"; (7) the Motmots which produce these racket tail feathers by biting, now produce incipient rackets hereditarily. These arguments (?) hardly carry conviction; but if the truth be that the rackets are the inherited effects of attrition, one asks why so few feathers specially exposed to attrition by twigs and sides of holes, &c., as the external rectrices and remiges of all birds, and specially the exterior *lengthened* feathers of wedge-shaped tails (*Dicrurus*), are neither bare nor racket-shaped nor incipiently so. One points also to the middle tail feathers of the male *Paradisaea rubra*, which—judging their development by the progress of their moult, as the authors do—begin "rather shorter than the rest of the tail," then are "moderately lengthened and with webs narrowed in the middle," and finally end

in a "black horny riband, bearing at its extremity a spatulate web" (Wallace). Why have the females of *Parotia sexpennis* no spatulate occipital plumes, and those of the spatulate or bare rachised-tailed Birds of Paradise no rackets, if the character is a non-sexual one? In the case of the Motmots, may not the narrowing of the web of the tail feathers be due to some physiological, pathological, or other cause, which attracts the bird's notice to the spot, causing it to peck at the feather and eventually bite away its webs; a habit which might become as fixed as the biting of the nails is from parent to children in many families. In the specimens which lived in the Zoological Gardens in London the central tail feathers came in with the webs on and were bitten off by the birds. The spatulate feathers would not arise, or would be lost, probably, if the Motmots left their tails alone. The very varied positions in which these singular plumes appear (altogether only in a few groups of birds), seem to indicate that it is not a question of attrition or excitation on objects with which the feathers come in contact, otherwise the occurrence of similar feathers would be far more common than it is, especially in the families to which the birds sporting such ornaments belong, since their habits, flight, and movements are similar. And if the rush of air through the feathers of the wing of certain pigeons can produce attenuation of their first primary, the same, or at least some, effect ought to be produced by the same cause, not only in many other pigeons, but also in hosts of other birds.

The final section of the introduction discusses the geographical distribution of the birds of the Celebesian area, and shows that it is inhabited by 393 species, and that fifteen genera and 108 species are peculiar to it. Each species is fully treated of in the systematic part of the work, as to its synonymy and diagnosis, with interesting and often lengthy accounts of its distribution and habits. Of these, seventy-seven are figured in forty-five plates by Herr Geisler, the artist of the Dresden Museum, who has, at the request of the authors, represented "the exact hue of the specimens painted, sometimes at the cost of the artistic effect and clearness of tint seen in the English productions." The work is also embellished by seven maps—two climatological, two topographical, and three devoted to geographical distribution.

As a result of their laborious investigations, the authors find that

"one-half of the peculiar birds of Celebes have their nearest affinities in the Oriental Region, and one-fifth only in the Australian Region; but the Australian forms seem to be, on the average, rather more strongly differentiated than the Oriental forms. . . . The origin of the Celebesian avi-fauna is principally an Asiatic one, but Celebes, as a whole or as a group of islands, was separated early from the Continent, or never was intimately connected with it. . . . The special faunas of Celebes, however, . . . are far from worked out. . . . The future, therefore, only can decide whether the ornithological facts as at present known teach us correctly that Celebes belongs to the Oriental Region and not to the Australian. . . ."

The authors are to be congratulated upon the production of one of the best and most exhaustive ornithological monographs of a special region that have for a long time appeared either in England or on the Continent.

NO. 1591, VOL. 61]

PUMPING IN MINES.

Mine Drainage; being a Complete Practical Treatise on Direct-Acting Underground Steam Pumping Machinery. By Stephen Michell. Second edition. Pp. xviii + 369. (London: Crosby Lockwood and Son, 1899.)

AS a somewhat heterogeneous collection of statistics, drawings and descriptions of pumping machinery, the work before us probably stands unrivalled in our own or any other language. It is profusely illustrated by means of excellent phototypes and woodcuts of pumping engines, as well as the details of their valves and valve gear, and contains minute verbal descriptions of their construction and mode of action. According to the author, most of the drawings have been supplied by the engine-makers, a fact with which no fault can be found, since there is no better source from which illustrations for a work like this can be obtained. But when we come to a consideration of the verbal descriptions the matter assumes a different aspect. Except in those cases in which an author feels himself bound to explain the views or original work of another author with precision, so as to avoid the possibility of misconstruction, descriptions quoted verbatim are out of place. In describing appliances with which he is, or ought to be, familiar, he should do so in his own words and from his own point of view, and at the same time give the reader the benefit of his opinions and criticism. If he quotes page after page from trade catalogues as our author does, not omitting even letters of commendation from customers, he abdicates his claim to the position of an author and becomes a simple compiler.

The work before us partakes far too much of this character, being to a large extent a compilation of the contents of catalogues; and as this is a class of information that is liable to vary with the issue of each new catalogue, and can be always obtained post free, it is a pity to swell the bulk of a volume by inserting it without measure.

The first twenty-two pages of the book contain introductory matter, including a few definitions and a history of the Worthington and other pumps; then follow four pages filled with the names of pumps and their makers, and thereafter the subject-matter is proceeded with. Hydraulic and electric pumps, together with four and a half pages of "Hydraulic and other memoranda," are, for no apparent reason, relegated to an appendix; and the volume closes with a good index.

In linking up the subjects and in venturing to express his own opinions, the author is not always equally happy in his remarks. For instance:—

"Height is essential to effectiveness in an air-vessel, mere lateral extension of volume adding little to its value" (p. 72).

"The pump valves act a most important part in the action of the pump. Indeed, their function is a most important one, and they may fitly be described as the 'lungs' of the pump" (p. 82).

"A speed of 100 feet per minute is quite sufficient for small steam pumps if an excessive resistance in the rising main is to be avoided" (p. 94).

Apart from the resistance due to the head, which is the same whether the pump is large or small, a pump

encounters no other resistance in the *rising main* or discharge pipe, except that due to the friction of the ascending water. The amount of that resistance is a function of the velocity of flow, the area in cross-section, and the length of the discharge pipe, and is in no other way related to the size of the pump.

"The Kaselowsky system is similar to that of Messrs. West and Darlington, originated many years ago, and developed in the last dozen years in the Scotch collieries by Mr. Moore. The chief features in which it differs therefrom are the use of accumulator pressure and a very long stroke, admitting of considerable reduction in the dimensions of the underground engine" (p. 340).

Just before summing up in this way, our author has filled two and a half pages with a description of Kaselowsky's system, furnished by the Berliner Maschinenbau Actien-Gesellschaft, which he says "may be comprehensible."

Moore and Kaselowsky both transmit power by means of a forcing pump actuated by steam at the surface through two pipes filled with water to a pumping engine situate at the point in the mine from which water is to be raised. In Moore's pump, the water in each pipe moves first in one direction, and then in the opposite direction, acting the part of a rigid rod in its downward stroke, and the pumping engine in the mine oscillates in exact synchrony with the water in the pipes and with the forcing pump at the surface. Thus, if there were no leakage of motor water, each pipe would always remain filled with the same water that was originally put into it. Neither the forcing pump at the surface nor the pumping engine in the mine requires to have any distributing valves. The principal objection to this pump is that the pipes being subject to variations of pressure, expand and contract alternately, so that part of the stroke of the forcing pump, and consequently part of the work expended in driving it, is lost.

In Kaselowsky's pump, on the other hand, the motor water flows in a closed circuit, descending in one of the pipes and ascending in the other. The excess of pressure in the former over that in the latter is created by the forcing pump on the surface, and is expended in working the pumping engine in the mine. Both the forcing pump and the pumping engine are necessarily provided with distributing valves.

The pumping engine in the mine consists of two complete engines and pumps fixed side by side on the same bed plate, each of which actuates the distributing valves of the other in exactly the same way as this is done in a Worthington pumping engine. The accumulators to which our author refers are three in number. Their purpose is to prevent the occurrence of shocks in the motor water when the distributing valves open and close. The motor water, travelling from the forcing pump towards the pumping engine, passes under the plunger of the first accumulator just after it leaves the forcing pump at the surface, under that of the second just before it enters the distributing valve chest of the pumping engine in the mine, and under that of the third just after it leaves the same valve chest. They act exactly the same part towards the motor water as an air-vessel does towards the water discharged by a pump.

The difference between Moore's pump and Kaselow-

sky's is therefore a very wide one, and does not consist in "the use of accumulator pressure and a very long stroke," as we are so confidently informed.

In the hydraulic and other memoranda we find:

"Dia. of circle or cylinder $\div 7854 = \text{area.}$ "

This must certainly be an oversight.

The rules for finding quantities are very arbitrary, as the two following examples will show, and no explanation is offered as to how they have been concocted.

Thus:—

"Square of dia. in feet \times five times the depth in feet = gallons."

"Square of dia. in inches = lbs. of water for 3 feet long $\div 10 =$ gallons."

Although the book is called "A Complete Practical Treatise," there seems to be no good reason why the hydraulic and other memoranda should have been pitched upon such a low level as to appeal only to the capacity of those who can do little more than read or write. The School Boards and the Science and Art Department, now Board of Education, have for a number of years past been training many boys and men who are destined to irresistibly supplant the rule-of-thumb class for whom such rules were originally framed. The least of these would scorn to have a set of hard and fast rules thrust upon him without some kind of explanation, and no writer of the present day can afford to ignore this fact if he expects his work to be appreciated and to have a permanent value.

Mr. Michell's book is altogether too voluminous. In the first paragraph of his preface he strikes the key-note that should have been his guide in writing it, namely:—"Many of the engines in use when the work was first published have, in the severe ordeal of underground work, maintained their position as useful and effective pumping agents; others have failed, and are now only a name in the chronicle of mine pumps."

Thus, judging by the past, we may be quite sure that many more of those now in use will likewise disappear from the scene. If, instead of describing as many pumps now in use as he could find space for, our author had instituted careful inquiries to find out the most economical and trustworthy amongst them, if he had confined his attention solely to these, condensed his book to about one-quarter of its present size, and embodied a few leading formulæ in their proper places in the text for the use of the student and the educated man who is now, and is also yet to come, he would have produced a more interesting, readable and useful work than the one now before us.

We differ entirely from the views expressed by him to the effect that "In collieries with plenty of refuse coal and slack of no commercial value, much of it, perhaps, worth only a shilling or two per ton, a small initial outlay rather than economy in working, and a plant that occupies little space in the pit..." can ever be a consideration of such great importance in the eyes of a properly educated colliery manager as to determine him to adopt an uneconomical pump because of its cheapness in first cost. Such a man would foresee that additional boiler-power and additional labour for stoking the boilers would be required to supply steam to the wasteful pump.

He would therefore spend an additional sum on the pump itself rather than on the purchase of boilers and in stoking, and he might even be sufficiently far-seeing to capitalise the value of the coal he would save, and spend part of that amount also upon the pump.

In conclusion, the opinions expressed by our author to the effect that a pump placed in a chamber underground is for that reason necessarily neglected, and subjected to rough and unskilful treatment, that it cannot be so economical as an engine working on the surface, that steam pipes in the shaft heat the workings, and so on, all tend to betray a want of knowledge of the practice of educated and observant engineers and managers of the present day. They sound rather like an echo from the uninstructed past, or a diige of the days that are now passing rapidly away.

W. GALLOWAY.

THE PALAEOLOGY OF THE INVERTEBRATA.

Text-Book of Palaeontology. By Karl A. von Zittel. Translated and edited by Charles R. Eastman, Ph.D. Vol. i. Pp. viii + 706; with 1476 woodcuts. (London: Macmillan and Co., Ltd., 1900.)

ENGLISH-SPEAKING geologists and palaeontologists have awaited with eagerness the long-promised translation of Prof. K. A. von Zittel's well-known "*Grundzüge der Palaeontologie*" which appeared early in 1895. At last we have received the first volume, which completes half the work, namely, to the end of the Invertebrata. It proves, however, to be much more than a translation of the German original. It is illustrated by the same beautiful woodcuts, with few additions; it is also similar in general plan; but most of the chapters have been entirely rearranged and rewritten, to express the views of the various American and English authors who have co-operated with Dr. Eastman. It is, therefore, virtually a new work, and the scheme of classification adopted is very different from that accepted by the eminent Professor of the University of Munich.

The only part of the "*Grundzüge*" which remains almost unchanged in the present translation comprises the admirable introductory chapter and the account of the sub-kingdoms Protozoa and Coelenterata. Here the student will find Prof. von Zittel's own summary of his important researches on the structure and classification of the fossil sponges, which it is well to have left untouched. Changes begin with the Echinodermata, and attain their maximum in the Cephalopod Mollusca, becoming less noteworthy again in the Arthropoda, which conclude the volume.

Of the Echinodermata, the Crinoidea and Blastoida were revised by the late Charles Wachsmuth. He added much new matter, and described and classified the crinoids in accordance with Wachsmuth and Springer's "*Monograph on the Crinoidea: Camerata of North America*," which is here said to be "as yet unpublished," but really appeared in 1897. The sections on Asterozoa and Echinozoa have been extended, and in some respects much improved, by Mr. Percy Sladen, who has completely rearranged the Euechinoidea in accordance with the

researches of the late Martin Duncan. The short description of the Vermes has been revised and slightly enlarged by Dr. G. J. Hinde. The chapter on Bryozoa is no longer that of Prof. von Zittel, but the work of Mr. E. O. Ulrich, who has added many new figures. It is not quite up to date, there being no references to Dr. Gregory's "*British Museum Catalogue*" or his memoir on early Tertiary Bryozoa, published by the Zoological Society. The Brachiopoda, revised and partly rewritten by Mr. Charles Schuchert, are arranged according to Beecher's classification, which is described in von Zittel's original as "one-sided," being based only on embryology. The rearrangement of the Mollusca has been undertaken by Messrs. Dall, Pilsbry and Hyatt, who deal respectively with the Pelecypoda, Gastropoda and Cephalopoda. Here it is difficult to recognise any of the original "*Grundzüge*" except the figures. In the description of the Arthropoda, Prof. Charles E. Beecher has added much important new matter to the section on Trilobita, which students will be glad to have. The treatment of the higher Crustacea and Merostomata is also much changed by the revision of Profs. Clarke and Kingsley; but the Arachnida, Myriopoda and Insecta, edited by Mr. Scudder, remain almost as in the original German work.

With so many collaborators, it has naturally been impossible for Dr. Eastman to obtain uniformity of style throughout the volume; and the judgment which teachers and original workers will pass upon it depends largely on the section which they happen to consult. On the whole, we are disposed to prefer the original volume in the form in which it was issued by the distinguished teacher who prepared it. With all due deference to the eminent specialists who have devoted so much labour to the translation and revision, we cannot refrain from expressing our opinion that they have converted an admirable student's manual into little more than an index to certain technical memoirs, which are as yet by no means accepted classics in palaeontology. As Prof. von Zittel himself remarks in his preface, many of these memoirs are founded on certain embryological and phylogenetic considerations, which may soon prove to be baseless assumptions; while the old methods of comparative anatomy are often almost abandoned in favour of some one-sided hypothesis. We would also note that a large proportion of the generic names adopted are quite unknown in the original works on geology and palaeontology which the average student will have to consult at the beginning of his career. In short, if the translators and revisers had devoted more attention to the correction of errors or the incorporation of new facts, and displayed less eagerness to infuse their own personal idiosyncrasies into the work, they would have done much more valuable service than they have actually accomplished.

The subject is too technical to enter into detailed criticism, and it must suffice merely to allude to three points in illustration of the difficulties which are placed in the way of the student.

One of the first fossils which every student must learn to know is the brachiopod *Terebratula*. Accordingly, Prof. von Zittel, in his "*Grundzüge*," gives a concise

description of this shell as ordinarily understood in standard literature. Mr. Schuchert's translation, on the other hand, has:—"Terebratula, Klein, 1753 (Fig. 551). Genus not well known. Mesozoic or Tertiary." He merely gives a list of ill-defined generic names of no value whatever, except as an index to certain special memoirs which he happens to approve.

In the Mollusca Pelecypoda, Dr. Dall must have devoted great labour to his exhaustive revision; but, from the student's point of view, it would have been much better if he had bestowed it on the correction of mistakes. In the description of *Pseudomonotis*, for example, "left valve" is copied from the original German, although even the accompanying figure must have shown the translator that it was a mistake for "right valve."

Finally, every student must know something of the common *Nautilus*. If he looks at Prof. Hyatt's description (p. 526), he will learn that it is a recent genus, and may perhaps range backwards to the Tertiary; but if he turns to Figs. 1075 and 1076, he will read that species of the genus occur in the Middle Lias and the Tithonian. Which of these two contradictory statements does Prof. Hyatt intend the unfortunate student to accept? We presume he intended to re-name the illustrations *Cenoceras*, and, like Dr. Dall, was too much occupied with the greater rearrangements to take note of the minute points on which the real value of a text-book depends. In fact, not only in this instance, but throughout Prof. Hyatt's section on Cephalopoda, the student will find hopeless confusion and receive practically no aid in plodding through the current literature of geology and palæontology. Nearly a hundred new generic names, introduced without definition, add in no small degree to the difficulties.

While, however, the elementary student, for whom the "Grundzüge" was written, will meet with disappointment when he attempts to use its English counterpart, the more advanced student engaged in original research will welcome the handsome volume which Dr. Eastman has produced. It is a valuable work of reference, which ought to find a place in every geological and biological library. We hope it will soon be followed by the second volume, containing the Vertebrata, which will make the English "Zittel" the most exhaustive and valuable treatise on palæontology in our language.

INADEQUACY OF THE CELL-THEORY.

Les Êtres Vivants. Organisation—Evolution. By Paul Busquet. Pp. 181; 141 figures. (Paris: Carré and Naud, 1899.)

WHAT the particular secret of this volume is, we have been unable to discover, except that it is intended as an argument for a franker recognition of the unity of the organism, and as an argument against the view which regards the multicellular creature as a "cell-state" or as a colony. To discuss these difficult matters profitably requires great competence, and we do not think that this is shown by the author, who, for instance, cites the old report that the ectoderm of a Hydra turned inside out becomes endoderm, and so on, and uses this

as an argument against the original distinctiveness of the two germinal layers. Furthermore, while an attack on a position often means progress, one must master the previous moves, and we see no evidence that Dr. Busquet has done so. Has he seriously considered, for instance, Whitman's notable essay on "The Inadequacy of the Cell-Theory of Development"?

A pleasing feature of the book is the author's grateful tribute to his master, Prof. Kunstler, whose views he expounds and elaborates. Thus he begins with a defence of Kunstler's conclusion that protoplasm is composed of series of minute elements, more or less globular, either placed in apposition or separated by fluid. This alveolar or "spherular" structure of protoplasm was described by Kunstler in 1881, and has been familiarised by the researches of Bütschli (not Butschli, as the author persistently calls him, just as he calls Kölliker—Kolliker, which is absurd). We do not notice any mention of Flemming, though his lifelong observations on reticular structure, and his criticism of the demonstrations of alveolar structure, must be taken account of if one wishes to be treated seriously in discussing such matters.

The author points out that just as Dutrochet (1824) and Turpin (1826) may be said to have priority over Schwann and Schleiden in formulating the "Cell-Theory," so Kunstler must be credited with priority over Sedgwick, Whitman and Delage in demonstrating its inadequacy. For Kunstler maintained long ago that the cell is no primitive morphological unit, but an acquired mode of organisation, and that the cellular structure of the Metazoa is a secondary result adaptive to functional convenience. The frequent vagueness of cell-limits, the abundant illustrations of inter-cellular bridges, and the occurrence of indisputable syncytia are forcibly indicated by the author.

It is argued that to think of a Metazoon as derivable from a colony of Protozoa is misleading; and that although there are some true colonies among Metazoa, e.g. in Cœlenterates and Tunicates, the colonial or polyzoic hypothesis, especially elaborated by Perrier, is a specious fallacy. We are asked to choose between two alternatives—the Metazoa are colonies of individualities of a lower order, or they are individualised irreducible unities. But it is not made plain why we may not suppose that the ancestral forms of various stocks passed through an imperfectly integrated colonial or polyzoic stage.

The author takes a survey of the animal kingdom, and seeks to substantiate a number of general conclusions, which we shall try to summarise. Living matter shows "a general and universal tendency to proliferation or repetition of similar parts." "These phenomena of repetition appear at first in the adult, where they constitute an acquired character; in the embryo they are but the reproduction more or less modified, by coenogeny, of what exists in the perfect individual." But in certain circumstances the repeated parts may coalesce, exhibiting a secondary and acquired simplification, and bringing about a recondensation of the organism, preparatory to a recommencement of the evolutionary process on some new line. Types do not arise by a slow and direct transformation of pre-existing forms, but each is a new

genesis. "The law of the formation of new types is a fragmentation of the tissue of more primitive organisms, and the arrangement of these new formations in new groups." "Neither selection nor adaptation can explain the specific peculiarities (particularités) of the structure of organisms, which are due to new spontaneous productions."

Thus the reader is insidiously led from harmless admissions as to the structure of protoplasm to grave heresies in regard to the efficacy of natural selection; but if he is convinced, we confess our inability to understand how the trick is done. We think that the sound part of the book may be summed up in a sentence of E. B. Wilson's: "Broadly viewed, therefore, the life of the multicellular organism is to be conceived as a whole; and the apparent composite character, which it may exhibit, is owing to a secondary distribution of its energies among local centres of action." J. A. T.

OUR BOOK SHELF.

Notions de Minéralogie. Par A. F. Renard et F. Stöber. 1^{re} fascicule. Pp. iv + 189; 398 figures. (Ghent: Ad. Hoste, 1900.)

A TEXT-BOOK of mineralogy, written by the Abbé Renard, with the co-operation of his assistant, F. Stöber, who has published important mineralogical papers, excites high expectations; and, in spite of its modest title, this work is really a text-book. The present volume contains only the introductory portion, dealing with the geometrical, physical and chemical properties of minerals. A second part is promised, which will contain the description of various species and a notice of those found in Belgium.

The excellent historical survey with which the book opens is modelled upon Fletcher's well-known "Introduction to the Study of Minerals"; it is only brought down to the year 1833. In the following section (geometrical crystallography) some of the principal types of crystals, and their planes of symmetry, are indicated by projections of the "elementary spaces" (the systematic triangles of Maskelyne) similar to those used by Liebsch in his "Grundriss der Krystallographie"; axes of symmetry are not employed, but the familiar conception of hemihedrism is retained; and the facts are stated in a manner which involves no special mathematical knowledge. Indices are used throughout. The subject of twinning is briefly treated, and only by reference to twin planes. In the optical section use is made of the wave-surface and the ellipsoid of optical elasticity.

Since out of 189 pages eighty-eight are devoted to the geometry, and fifty-seven to the physics, of crystals, the chemical section is very brief, but considerable attention is, as might be expected, devoted to microchemical analysis, and also to crystal etching.

The reader will not expect to find much that is novel; neither will this book give him an insight into modern theoretical aspects of the subject; but he will find, what is more important, a very lucid statement of the essential facts, and a clear description of the practical methods in use by mineralogists; to illustrate this, special attention may be called to the paragraph on the angle of minimum deviation on p. 116, and to the interpretation of interference figures by the diagrams on pp. 138-9.

It must not be imagined from what has been said that the book ignores new advances in the science; there is, for example, a paragraph on the use of X-rays.

The figures are adequate, but not very well printed.

NO. 1591, VOL. 61]

When the second part appears, we shall expect to find that it completes a very readable and useful student's handbook. H. A. M.

Muret-Sander's Encyclopaedic English-German and German-English Dictionary. Pp. xlviii + 1733. (London: H. Grevel and Co., 1900.)

BEFORE buying a dictionary of words of a foreign language the purchaser has to make up his or her mind as to what *kind* of a dictionary is required. There are, for instance, dictionaries which can easily be placed in the waistcoat pocket: these necessarily contain a very restricted number of words. From this they gradually increase in size, weight, and quantity of information given, until they assume such proportions that they are best kept in one place and referred to there, as their bulk renders them somewhat inconvenient to move.

The volume before us, which is described as an abridged edition, may be said to be verging on the larger size of dictionaries, as its dimensions are 11 x 8 x 3 inches, and it contains nearly 1800 pages.

The plan and arrangement of the work are uniform with the well-known French-German dictionary of Sachs-Villatte, and the pronunciation adopted is based on the phonetic system employed in the method of Toussaint-Langenscheidt.

The volume should find special favour with students of science, for, although it is in no sense technical, there is a sufficient sprinkling of scientific terms throughout its pages which should render it most useful to this large class of readers. To find out the extent of the insertion of technical terms, we have chosen at random some chemical terms such as ozone, hydroxide, vanadium, fractionation, nitrate, and find that all except one are included. Repeating the same for physical terms, we find ampere, watt, electrolysis (absent, but electrolyse inserted), galvanism, achromatic, all but one mentioned.

Some readers may dislike the use of the German type when German words are printed, since most of the German scientific publications are now printed in Roman type; any one, on the other hand, familiar with the German language, will probably prefer the usual German letters. In addition to being clearly printed, the volume is strongly bound, and is issued at the moderate price of fourteen shillings.

Die Elemente der Entwicklungslehre des Menschen und der Wirbeltiere. By O. Hertwig. Pp. vi + 406; 332 figures. (Jena: Gustav Fischer, 1900.)

THIS work is a condensation of the sixth edition of Hertwig's well-known "Lehrbuch," brought out in a form more suited to the needs of beginners and students, especially of medicine. It is intended "to serve as an introduction to the field of embryological science, and to put forward only its leading facts in a shorter form." Hence the discussion of controversial problems is omitted, as well as historical reviews or references to literature, for which the more advanced student must consult the larger work. Each chapter concludes with a "repetitorium," by which is meant a numbered series of categorical statements, summing up briefly the results obtained in the foregoing chapter. There are numerous illustrations, the pick of those in the "Lehrbuch." The book is doubtless one which will be very useful to the German student, but unless it is translated, it may be doubted if it will have a very large sale in this country, since the English student of the class for which it is intended is not able, as a rule, to read easily books in a foreign tongue, while those who take their science enough in earnest to acquire this faculty, will probably purchase the larger work. For the teacher, however, the book offers a brief and convenient summary, very handy for reference. E. A. M.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

Recent Exploration in the Upper Air and its Bearing on the Theory of Cyclones.

ABOUT ten years ago there was an interesting discussion in regard to the theory of cyclones, by such leaders in meteorology as Ferrel, Blanford, Hann and Davis (see NATURE, vol. xliii. p. 82 and p. 470). Since then, considerable new material has been accumulated by research in the free air with kites and balloons, and it seems appropriate to consider its bearing on current theories.

In America the work with kites, by Mr. Rotch, has resulted in the discovery of the following facts:—

(1) The atmosphere is separated by sharply marked inverted vertical gradients of temperature into superposed strata, each stratum potentially warmer than the one beneath. By potentially warmer is meant that if any stratum were brought down, it would be heated by compression and become warmer than the stratum it replaced. There are usually two, and sometimes three, strata between the ground and the altitude of 3000 metres. The boundaries between these strata are regions of sharp contrast in a vertical direction of temperature, of humidity (both absolute and relative), and sometimes of wind direction. These boundaries are also regions of maxima in wind velocity, and the regions where clouds are chiefly found.

(2) In the changes of condition of the atmosphere from day to day, the minima of temperature and humidity occur simultaneously at all levels, except that in a superficial stratum within about 300 metres of the ground, the minimum sometimes occurs later as a result of surface cooling.

(3) The air column up to 3000 metres above barometric minima at sea-level averages about 10° F. warmer than the air column up to 3000 metres' above barometric maxima at sea-level.

(4) All the conditions which characterise the surface cyclone and anticyclone, such as the circulation of the wind around a central area, the clouds and the rainfall, usually do not exceed the height of 3000 metres. Above that height there is an entirely different distribution of pressure and wind circulation from that observed at the earth's surface.

(5) In the areas of low pressure in the upper atmosphere the air is cold, extremely dry and clear. In the areas of high pressure in the upper atmosphere the air is warm and frequently moist.

In kite-flights made on November 24 and 25, 1898, at Blue Hill, there were evidences of three distinct wind-circulations. The surface cyclone did not exceed 800 metres (or half a mile) in thickness, and above this was a warm-centre cyclone with dense clouds and precipitation about 2000 metres in thickness. At the height of 3000 metres (or about two miles) the wind, on November 24, was found blowing from the south and circulating around an area of low pressure with a cold, dry central area; while at the same time at the surface of the earth the wind was from the north and circulating around a warm-centre surface cyclone. (See *Bulletins* No. 1, 1899, and No. 1, 1900, of the Blue Hill Meteorological Observatory).

In France, M. Teisserenc de Bort has made a study of the air by means of *ballons sondes* launched at frequent intervals from Trappes. His results show that the annual period in the temperature of the air is well marked up to and exceeding ten kilometres. They show further that during the irregular warm and cold periods in the atmosphere the isotherms rise and fall simultaneously at all heights up to at least ten kilometres. In other words, the warm and cold waves aloft occur simultaneously with those near the surface (see *Comptes rendus*, August 21, 1899).

Dr. Hergesell, of Strassburg, has discussed the records of the international balloon ascents, and derived a number of important conclusions. Among these are: (1) In the highest strata of the atmosphere attainable by balloons the temperature change from day to day, and the temperature gradients in a horizontal direction, are very marked. Within distances of only a few hundred kilometres are sometimes temperatures at the same level which differ as much from each other as 30° – 40° C. (2) Such temperature distributions as that which brought frosts in Europe on

May 13, 1897, are not local and confined to the earth's surface, but meteorological phenomena of great extent and importance which embrace the entire atmosphere above Europe. (3) By computing and plotting the air-pressure for the heights of 5000 and 10,000 metres, it was found that the areas of low pressure at these heights coincide approximately with the areas of low temperature, and in most cases are many hundreds of kilometres from the surface cyclone. Thus, on March 24, 1899, the surface cyclone or area of low pressure was along the north coast of the Mediterranean, near Italy, while the minimum pressure at 5000 and 10,000 metres was in Finland, or even further north (*Meteorologische Zeitschrift*, January 1900).

To compare these facts with theory, I have looked up the views expressed in modern text-books and recent literature. I find a number of different opinions in regard to the causes of cyclones, and have classified them as follows:—

(1) Instability produced by a rapid decrease of temperature with increase of height; that is, by a vertical gradient equalling or exceeding the adiabatic rate. This may be called the *theory of vertical instability*.

(2) Instability produced by differences of temperature in a horizontal direction. In such a case, in consequence of the difference in density, there is established a convectional interchange of air between areas of different temperatures, and there result differences of pressure, and consequently cyclones and anticyclones. This theory I call the *convection theory*.

(3) If a current of damp air is deflected upward by any means, mechanical or otherwise, it cools by expansion, and its moisture begins to condense. This condensation retards further cooling, so that the air in rising may cool at a rate less rapid than that ordinarily existing in the atmosphere. In such a case, the air would continue to rise, and the conditions would be favourable for storm formation, as long as the supply of moisture lasted. This has been called the *condensation theory*.

(4) When bodies of water, moving in different directions or with different velocities in the same direction, come in contact, whirls and eddies are set up between them. It is therefore conceivable that the large masses of air moving between the equator and the pole, may, at their places of meeting, produce similar large eddies, such as the cyclones of the weather map. These have been called *dynamic cyclones* and also *driven cyclones*.

Probably no meteorologist believes that any one of these causes acts entirely alone in cyclone formation. But a difference of opinion arises as to which is the principal cause, and to what extent the others are subsidiary causes. All theories agree in ascribing the primary cause to differences of temperature, either local or between equator and pole.

Vertical instability can scarcely be considered the primary cause of cyclones, because, as stated above, the atmosphere is found normally separated into strata, each one potentially warmer than the one beneath. The fatal objection to the condensation theory, as pointed out by Dr. Hann, is that cyclones in temperate latitudes are more violent in winter than in summer. Latent heat is not so effective an aid to storm action in winter as in summer, and yet it is in winter that our cyclones possess their greatest violence. According to the theory of driven cyclones, "The masses of air set in motion polewards by the upper gradients are resolved, in part, into great whirls, the principal progressive motion of which is controlled by the prevailing west component of the former. The influence of the inequalities of the earth's surface, the different heating and cooling of the land and ocean, and the bringing in of aqueous vapour and its condensation, come thus into account, as matters of secondary importance." (NATURE, vol. xliii. p. 470). "If . . . cyclonic and anticyclonic disturbances are produced by the irregular flow of the general winds, it is probable that these disturbances would originate in the higher regions of the atmosphere, where the winds blow much faster than near the earth's surface. The differences of pressure produced at high altitudes would be felt down to sea-level; and, as the lower winds move with comparative slowness, they would be governed by the gradients thus imposed on them by the irregular movements of the upper winds. According to this theory, an area of high pressure would be perceived at sea-level beneath a district where the upper currents crowd together; and an area of low pressure, or a cyclonic storm, would be developed beneath a region where the upper currents are somewhat divergent." (Davis's "Elementary Meteorology," 1894, p. 219.)

As stated above, observation does not show areas of minimum pressure in the upper air above areas of minimum pressure at

sea-level. Furthermore, according to the theory of driven cyclones, the progressive motion of the cyclone is supposed to be determined by the "prevailing west component" of the upper currents. At Blue Hill the mean westerly component of the upper current is 35 metres per second at 9000 metres, about 17 metres per second at 4000 metres, and 1 metre per second at 200 metres (*Harvard Observatory Annals*, 1890, vol. xl. p. 447). It is natural to suppose that a driven whirl, in such conditions, would be rapidly toppled over and destroyed. Yet storms persist for days. If, however, a driven whirl did persist in such conditions, its axis if tilted at all would, according to all analogy, be tilted in the direction of progressive motion. Yet the direct observations with kites at Blue Hill, and the observations of clouds by Ley in England, prove that the axis of the cyclone is tilted backward. Moreover, it is reasonable to suppose that the air in the rear of a driven whirl would partake of the progressive motion of the whirl, and this, added to the in-draught, would make the wind velocity in the rear of the whirl very much greater than that of the winds in front, yet such is not generally found to be the case. For these reasons I think the observations do not favour the theory of driven cyclones.

The theory of cyclones with which the observations in temperate latitudes seem best to agree, is the theory which supposes the cyclone to result from contrast of temperature in a horizontal direction. This I have called the *convection theory*. In this theory there are two types of cyclone. The warm-centre cyclone of the lower atmosphere, and the cold-centre cyclone of the upper atmosphere. The best type of the cold-centre cyclone is the polar cyclone; but there also exist in the upper air in temperate latitudes small travelling cyclones or *hemi-cyclones* of the same nature. Horizontal contrasts of temperature are most marked in winter, hence the theory explains why cyclones are most violent in winter. The origin of the horizontal contrasts of temperature is not shown by observation. They probably arise by the interchange of air between higher and lower latitudes. A body of air moving from the equator toward high latitudes would come into a region where it would be nearly surrounded by colder air, and the conditions would favour the production of a warm-centre cyclone. A body of air moving toward the equator would produce conditions favourable to a cold-centre cyclone.

H. H. CLAYTON.

Blue Hill Meteorological Observatory, March 30.

Rock-structures in the Isle of Man and in South Tyrol.

IF the intercrossing of two separate systems of folding be the essential condition in the complicated rock-structures so ably worked out by Mrs. M. M. Ogilvie Gordon in South Tyrol, I scarcely think the parallelism with the conditions in the Manx Carboniferous rocks can be so close as Mrs. Gordon suggests in her recent letter (*NATURE*, March 22, p. 490).

So far as I have been able to judge, the disturbances in the Carboniferous volcanic rocks of the Isle of Man were the result of a movement which was single both as regards direction and time. It is true that this conclusion was reached in 1897, before Mrs. Gordon had taught us the importance of torsion-structure in areas of disturbance; but I re-examined the sections last autumn, after having studied Mrs. Gordon's paper, without finding any reason to alter my former opinion on this point. The interpretation given in my recent paper (*Q.J.G.S.* vol. lvi. p. 11) is therefore in all respects the same as that published in brief in the official Summary of Progress of the Geological Survey for 1897 (pp. 110-112).

It seems necessary, also, to call attention to the small scale of the structures in question in the Manx Carboniferous rocks. Their most striking feature is their sudden local development in a limited tract where the strata are rendered by diverse lithological composition peculiarly susceptible to differential displacement. Under such conditions, it appears that even a small degree of lateral movement may be so focussed as to cause great disturbance at certain places without much disturbance of adjacent tracts. The post-Carboniferous movement in the Isle of Man can scarcely have been even approximately of the magnitude of the disturbances in South Tyrol described by Mrs. Gordon.

It was in pre-Carboniferous times that the Manx region underwent earth-movements of really grand intensity; and Mrs. Gordon may have had this fact in mind in referring to the subject. In the Older Palaeozoic (probably Cambrian) slate-rocks of the island, "crush-conglomerate" has been developed

on a very extensive scale by differential shearing, as described by Prof. W. W. Watts and myself five years ago (*Q.J.G.S.* vol. li. p. 563). These rocks, moreover, show evidence of successive epochs of disturbance, varying slightly in direction but apparently all pre-Carboniferous. The production of the "crush-conglomerate" appears to have occurred during only one of these stages. It is not improbable that an observer acquainted with the "torsion-structures" of the Dolomites might be able to find parallel phenomena among the highly complicated pressure-structures in the Manx Slates; but I think that a sharp distinction should be drawn between these structures and those of the Carboniferous rocks of the island. G. W. LAMPLUGH.

Tonbridge, April 8.

Electric Light Wires and Dust.

I BELIEVE that the collection of dust upon electric light wires and fittings is generally attributed to air currents, due to thermal causes, the same thing occurring, to some extent, with hot-water pipes. Recent experience has, however, convinced me that in the case of electric light conductors, electrostatic attraction is really the chief factor, particularly where the supply is at 200 volts from the street mains. In my office here I have several electric light cords strung across the ceiling. They are all exactly similar and under the same conditions, except that some of them have the switch in the negative and some in the positive conductor. The former gather dust to an extraordinary degree, and now, after a few months' use, have become quite an eyesore. The latter are practically as clean as when first put up. As is well known, the negative conductor of a street supply tends always to earth itself, and, as a matter of fact, in my case I find that the negative of my supply from the Westminster Co. is almost at earth potential. The positive, on the other hand, is nearly 200 volts above the potential of the earth. In this lies obviously the cause of the phenomenon. The wires which have the switch in the negative are nearly at 200 volts potential above the earth whenever the switch is off, while those which have the switch in the positive are at zero potential in these circumstances. Of course, when the switches are on, all the cords are under similar conditions, one conductor in each being nearly at 200 volts above earth, and the other at about earth potential. No doubt it is when the switch is off, in the case where it is in the negative conductor, that the accumulation of dust takes place. Having regard to the comparative lowness of the 200 volts potential, from an electrostatic point of view, the rate at which the dust accumulates on the cords is most surprising, and this is my reason for thinking it worth while bringing the matter to notice. A. A. C. SWINTON.

66 Victoria Street, Westminster, April 23.

ON THE SIZE AT WHICH HEAT MOVEMENTS ARE MANIFESTED IN MATTER.

IN the molecular theory of heat it is assumed that the motions of atoms and molecules are the motions upon which the phenomena of temperature depend. These motions are assumed to be very irregular, and the apparent uniformity of structure of a gas, for example, is attributed to the very small size and irregularity of the motions, which within any region of sensible size are the same, *on the average*, as within any neighbouring region. Within regions of molecular dimensions the distribution of motion is extremely irregular; neighbouring molecules are not in general moving at the same speed or possibly vibrating in the same way. Hence in this view the size at which heat movements are manifested in matter are of molecular sizes, *i.e.* from 10^{-7} to 10^{-8} cm.

In addition, however, to all this matter, motion and vibration, there are present ether motions of an irregular kind. Within any closed envelope at constant temperature the ether motions must be in statistical equilibrium with the motions in the envelope. The energy per c.c. of these ether motions will be considerable at high temperatures, and small at low ones. Many years ago I called attention to the energy per c.c. required in order to, in this sense, warm up ether, and showed that it was quite comparable with that required to warm up a rare

gas. Now the size at which these motions are developed are comparable with the wave-length of the ether disturbances of the period of the motion. In the case of irregular disturbances, such as cause temperature phenomena in solids and liquids, one cannot define precisely the size of the ether disturbances, because they are of all sorts of sizes, being irregular in the same way as the matter motions are irregular; but it is known that at each temperature there is a particular wave-length, round which the ether vibrations may be grouped, and that this average wave-length is shorter the higher the temperature. The wave-lengths of these vibrations, so far as they have been observed, vary from 2.4×10^{-3} to 10^{-5} cm.

It is at once evident that the average size of the ether motions is *very* much greater—quite a thousand times greater—than the size of the molecular motions. In the molecular motions we could not expect to find any irregularity of distribution within distances such as we can see with a microscope, because within a visible volume there will be millions of molecules, and the average motion will be all that we can expect to see. Is it necessarily so as regards the ether motions which exist on so much a greater scale? Is there any way in which these very much larger scale phenomena may be expected to affect matter on a scale comparable with their own size, and which consequently we might expect to be able to see, and which might produce effects on masses of matter consisting of millions of molecules?

We may consider in this connection an analogy from sound. In sound we can have small solid objects, such as masses supported by springs, which give out waves in air very much longer than the sounding object. A tuning-fork, for example, may be only a few centimetres long, and may give out waves a metre long. The balance wheel in a watch vibrating quarter seconds would generate waves—feeble ones no doubt, but still waves—80 metres long, or some 8000 times the linear dimensions of the vibrating object. Similarly the vibrations of molecules generate ether waves many thousands of times as long as the linear dimensions of the molecules. On the other hand, solid bodies may be much longer than the air waves they produce. A bar of steel vibrating longitudinally would be fifteen times as long as some of the air waves it would generate. A pipe full of air would be of about the same length as the air waves to which it would resonate, not less than about a quarter as long. If, then, we had a large number of sounding bodies, some small ones like small tuning-forks, balance wheels, and such like, and others like pipes of a size comparable with the air waves, we would expect that when the small ones were all sounding, the larger ones would resonate to their corresponding waves, and thus be set in vibration by the waves originated in the smaller bodies.

In the case of electromagnetic waves we should expect the same result. If there are bodies comparable in size with the heat waves in the ether which can have electromagnetic vibrations produced in them of the same periods as those emitted by the molecules, these bodies should resonate to these heat waves. Now, by utilising the ordinary process of conduction in metals, we know that it is possible for electromagnetic vibrations to exist in conductors of a small size, down to a few millimetres in diameter; and there is no reason to doubt that by means of conduction very much smaller bodies can have electromagnetic vibrations in them. Dr. Lodge, indeed, has suggested that the structures in the retina are of about the right size to resonate electromagnetically to waves of the frequency of the light waves that affect our eyes. Larger objects would resonate to the electromagnetic vibrations corresponding to the ordinary air temperatures. A sphere 10^{-3} cm. in diameter would, for instance, resonate to waves of about the greatest length that have been measured by Rübens and Nicholls, and a much larger one could have a harmonic of its funda-

mental tone excited in it by these waves. In addition to these vibrations in conductors, non-conductors of one specific induction capacity immersed in a medium of a different specific inductive capacity could also have syntonetic vibrations excited in them. From all this it seems quite certain that in small particles of matter there must exist, at all temperatures, electromagnetic vibrations of a size comparable with the wave-lengths existing in the surrounding ether.

What sort of effects might we expect to be produced by these electromagnetic vibrations? Is there any prospect of our being able to detect them? What amount of energy may there be in this form of vibration on each particle? These are questions to which I am afraid I can only give very vague answers. To the first question, as to what effects may be expected to be produced by these vibrations, I can only suggest in the first place an unequal heating of the particle. The parts of the particle which are the electric nodes, where the electric current alternates and where there are no electric charges, these parts should be kept at a slightly higher temperature than the electric loops. If the particle were not perfectly symmetrical, this would lead to an unequal heating of the particle as a whole, and this may be a cause of those so-called Brownian motions of small particles immersed in a liquid which are so very difficult to explain. In the second place, it may lead to a grouping together of molecules into masses of a size depending on the temperature of the liquid, and to a going about of these groups of molecules and a similarity of the vibrations of the component molecules which complicates the theory of temperature in a way that may ultimately, as I have before now pointed out, explain to some extent the difficulties at present surrounding this theory. In the third place, this may be connected with the conditions for the breaking down of simple viscous motion and the production of vortices in a liquid, though I hardly think an explanation on these lines is required; and, finally, it may be connected with crystalline forces, the structures in the eye, vital actions in small cells and on a small scale, as in the patterns on diatoms, and possibly with the temperature at which vital actions of certain kinds, such, for example, as consciousness, are possible. These are the merest guesses of a wild kind as to the possible results of what seems to be a *vera causa* for structures and actions in matter of a size comparable with the wave-lengths of light, and must be taken as merely wild guesses.

As to the second question, of the prospect of detecting these electromagnetic vibrations in particles of matter, its answer depends so entirely upon the first that I can only leave it to the investigators of the future to try and detect them. That such electromagnetic vibrations exist, I think, can hardly admit of doubt, any more than that the strings of a piano are kept in vibration when loud and irregular noises are produced in its neighbourhood.

As to the energy of the vibrations upon each particle, I cannot give any satisfactory answer. If the particle were in a region through which a series of plane waves of a constant type were being transmitted, it would no doubt be possible to solve the problem of determining the amplitude of its vibrations in particular cases of assumed shapes of particles. In the actual case of irregular disturbances I do not see, at present, any direct way of attacking the problem. It would apparently require to be attacked statistically, but I doubt whether this would lead to a true result, because there seems some reason to think that trains of uniform waves of considerable length do exist in the ether, and if there is any regularity of this kind in the ether motions, a purely statistical treatment, in which the vibrations were assumed to be quite irregular, would fail to lead to a true result. If the energy of these electromagnetic vibrations of its fundamental period on a particle is no greater than

corresponds to its one degree of freedom on Boltzmann's theory of partition of energy, I am afraid the amount of energy of this kind on each particle is hardly sufficient to account for any observable phenomenon. That it may, however, be much greater seems justified by the failure of this theory, so far as is known, in other cases, and this must be my excuse for calling attention to what seems certainly a *vera causa* for structures and actions in matter of a size comparable with the heat vibrations in the ether, even though the amount of this cause may, when fully investigated, turn out to be so small as to be insufficient to produce observable effects.

GEO. FRAS. FITZGERALD.

REPORT OF THE MALARIA EXPEDITION TO SIERRA LEONE.

FOLLOWING close on the "Instructions for the Prevention of Malaria," the Liverpool School of Tropical Medicine have issued the report of the malaria expedition sent out to Sierra Leone by that body in August last. Their objects, as stated in the report, were:—

(1) To find one or more species of insects hospitable to the human *Hæmaphysidæ* on the West Coast of Africa.

(2) To study the bionomics of these insects, with a view to suggesting better modes of prevention of malarial fever than those hitherto known to us.

The terminology adopted is that used by Major Ross in consultation with Prof. Herdman, already noticed in NATURE (August 3, 1899). It is proposed to abolish the word mosquito, and use the old English equivalent, gnat, as there is no difference between the two, and because the terms malaria and malarial fever no longer hold—they propose the term *hæmaphysidæ*, or gnat fever.

The genus *Anopheles* was chiefly looked for, because these had been shown to be concerned in the transference of the parasite. In the barracks at Wilberforce, Sierra Leone, 25 per cent. of the soldiers suffered from all three forms of malaria or gnat fever. All the gnats caught in the barracks were *Anopheles costalis* except one, and out of 109 of those examined, parasites were found in 27.

Some experiments on feeding *Anopheles* on a patient with *H. malarie* gave positive results, several young zygotes being found in the gnat. These gnats were caught in a building where there were no fever patients, and numbers of them had been examined and found free from parasites. When, however, *Anopheles* bred from the larvæ and kept in test tubes were applied to the skin of a patient, they were found not to feed copiously, and negative results, as regards zygotes, were obtained on dissecting them. It is suggested that the explanation of the failure was the non-fertilisation of the females; it seems that the female gnat requires blood for the nutrition of the eggs. If the ova are not fertilised, the blood is possibly evacuated without some digestive process being performed which may be necessary to the vitality of the zygotes.

Measures of precaution against the bites of gnats, and measures for reducing their numbers, are discussed in the chapter on prevention. It is remarked that neither Europeans nor natives made any effort to keep down the numbers of gnats, which constitute a very serious pest in Sierra Leone, as they do in all tropical towns. Both this report and the "Instructions for the Prevention of Malaria" should be invaluable to residents abroad, as indicating how they may protect themselves from the annoyance from gnats, and from the evil results that may arise from their "bites."

Experiments were instituted with a view to destroying

the adults or larvæ, and to prevent the insects from breeding. It was not always possible to discover the breeding pools of the *Anopheles* infecting a particular spot; for instance, none could be found at Wilberforce, the nearest pools where larvæ were found being nearly a mile away. Dr. Fielding Ould tried experiments with tar, and found the film on the surface of the pool lasted longer than a film of kerosene oil; while both killed the larvæ and prevented them from hatching so long as the film lasted.

In the addenda are some good micro-photographs of both zygotes and blasts from the gnat.

JOSEPH BERTRAND.

AMONG the heavy losses which science has suffered during the past few months, few will be the subject of such universal regret as the death, on April 3, of M. Joseph Bertrand. The loss will be felt, not only by mathematicians, but also by the great body of scientific men with whom Bertrand was brought into contact in his capacity of life-secretary of the Paris Academy of Sciences.

Joseph Bertrand was born at Paris in 1823, and at an early age commenced his mathematical studies under the guidance of his father, who had been a pupil of the École Polytechnique. Subsequently Bertrand entered the Collège de St. Louis, and at the age of eleven he succeeded in passing the examination for entrance into the École Polytechnique, although it was not till six years later that he actually entered the college, when he headed the list of candidates. As a boy, Bertrand would nowadays be styled an "infant prodigy," by analogy with the youthful musicians who created such a *furor* at London concerts a few years ago; and it is interesting to learn from M. Maurice Lévy that this title (*enfant prodige*) was actually bestowed on him by the scientific men who welcomed Joseph as a young colleague at an early stage of his existence. The analogy between music and mathematics seems, moreover, to have suggested itself to M. Jules Lemaitre, Director of the French Academy, who remarks that such precocity of genius is sometimes found in mathematics and in music, but is never seen in literature. We find Bertrand publishing a paper on the theory of electricity in 1839, when he must have been about sixteen years old, and it is hardly surprising in view of this to learn that his precocity amazed his masters. In 1841 he wrote papers on indeterminate forms, Jacobi's theorem and differential equations, and from that time onward he was fairly launched on his career as a writer of mathematical papers, his output being five papers in 1842 and seven in 1843. But whereas most of the young musical *débütants*, to whom reference has just been made, have enjoyed only ephemeral reputations, and have exhausted their energies in their premature efforts to an extent which must have prejudiced their future careers, Bertrand succeeded in achieving all that was predicted of him; he showed no diminution of energy in advancing years, and, moreover, to judge from all accounts, he developed into a good man of business, a quality which is commonly regarded by "the general public" as incompatible with being a genius.

In 1842 he had a narrow escape from being killed in a railway accident near Meudon. In company with his brother, Alexandre Bertrand, now distinguished as an archæologist, he had gone to Versailles to see the fountains, and on the return journey the accident occurred in which Admiral Dumont d'Erville was killed. Both of the Bertrand brothers suffered, Joseph losing the bridge of his nose—a misfortune which disfigured him for life—while Alexandre's leg was fractured. Joseph rescued his brother by dragging him through "the skylight," the carriage doors being locked. A few months later he

married the sister of one of the injured, a Mademoiselle Acloque. At the Polytechnique, Bertrand acquired a knowledge of mining, and on leaving he became an inspector of mines. He was subsequently appointed professor at the Lycée St. Louis.

In March 1844 he became teacher of analysis (*répétiteur d'analyse*) in the École Polytechnique; from 1847 to 1851 he was examiner for admission to the same institution, which raised him to the rank of professor of analysis in 1856, a post which he held till 1895, just after he had completed his jubilee as a member of the teaching staff, an event which was commemorated on May 27, 1894, by a committee of his old students, who presented him with a medal engraved by Chaplain. In 1847 he was appointed deputy professor to Biot in the department of physics and mathematics at the Collège de France, and on the death of Biot, in 1862, he was appointed to the chair. From then up till 1890 he lectured regularly, with the exceptions that his work was taken by Darboux in 1867, by Maurice Lévy in 1874-76 and 1878-85, by Laguerre in 1885-86; since 1890 Marcel Deprez has acted as his deputy. We have it on the authority of M. Gaston Paris, that his first course of lectures was on a comparative study of the theories according to which geometers had attempted to account for capillary phenomena, his latest lectures being on electricity, thermodynamics and theory of errors. From 1858 to 1862 he was professor of higher mathematics at the École Normale Supérieure, and he also is stated to have held a professorship of special mathematics in the Lycée Napoléon. In 1856 Bertrand was elected a member of the Académie des Sciences at the early age of thirty-four, in place of Sturm; and on the death of Élie de Beaumont, in 1874, he was elected permanent secretary, in which office he had Berthelot as a colleague. He was made officer of the Légion d'Honneur in August 1867, and commander in December 1881. In 1884 he succeeded Jean Baptiste Dumas in the French Academy.

Bertrand's larger works—namely, his "Traité d'Arithmétique," published in 1849; his "Traité d'Algèbre," published in 1856; and his "Traité du Calcul différentiel et intégral," brought out during the years 1864-70—are accepted as standard treatises by mathematicians in all countries, the last named of the three being perhaps the most widely read of all. His treatise on Arithmetic contains, for the first time, a clear definition of incommensurable quantity. His treatise on the Calculus contains a large number of geometrical applications embodied in his divers memoirs; and special mention may also be made of his exposition of the theory of functional determinants and the close and useful relation which he established between these determinants and the simple derived function of one variable. It is greatly to be regretted that the manuscript of the third volume of this work was destroyed in a fire. A similar misfortune befel the manuscript of his original treatise on Thermodynamics, completed in 1870. In this case, however, the loss has been repaired by the publication of a book on the same subject at a later date, based on a course of lectures given at the Collège de France. Those who have grappled with such a subject as thermodynamics will appreciate his naïve observation that he has not attempted to make a complete treatise, and that he has only expounded what he has understood. But, as M. Lévy justly goes on to remark, on those points which he pretends not to have understood, notably on irreversible phenomena and the application of the Second Law to bodies of non-uniform temperature, he has made a series of critical remarks of great importance, which have already borne fruit. This treatise, moreover, is remarkably rich in illustrative examples all more or less original, those dealing with saturated vapours coming well within the range of practical applications. Other works emanating from his pen are an edition of Lagrange's

"Mécanique analytique," with copious notes, and a small volume of lectures on electricity, in which Bertrand gives the true origin and reason of Faraday's notion of "electric flux," although, being a mathematician, he naturally favoured the rigorous methods of Ampère, for whom he expressed great admiration.

Passing from these standard treatises to the numerous papers published in scientific journals, a glance down the list of these shows that, from the outset, Bertrand devoted his attention largely to applied mathematics, and to those portions of pure mathematics required in the solution of problems in applied mathematics. His early papers deal chiefly with the differential and integral calculus, differential equations, the calculus of variations, analytical mechanics, and in particular the integration of the equations of dynamics. His papers on the theory of surfaces, dating from 1843, on the principle of similitude in mechanics, on the propagation of sound and on capillary phenomena, are among the best known of his minor writings. After 1864, we find him writing biographical memoirs, commencing with Copernicus, Tycho Brahé and Fresnel, and followed up in later years with Comte, Lavoisier, D'Alembert (1889) and Pascal (1890). In 1868, Bertrand commenced a series of papers on hydrodynamics; flight of birds came under his "ken" in 1871, and in the same year he turned his attention to lunar theory. In the three years 1871-73, he contributed quite a number of papers dealing with electricity and magnetism, including the mutual action of currents, &c. In the period 1874 to 1883, the subjects treated included the sun, figure of the earth, electricity and magnetism, electric transmission of power, the Foucault pendulum, the theory of probability. Probability was always a favourite subject with Bertrand. The numerous pitfalls connected with the solution of problems, the remarkable power of prediction which the theory appears to afford, had a great fascination for him, and many were the courses of lectures which he delivered on this subject, not only at the Collège de France, but even in the less advanced classes at the École Polytechnique, where the subject was introduced by him chiefly in connection with its bearing on astronomy and the applied sciences, such as civil and military engineering.

We have spoken, too, of Bertrand's papers on Foucault's pendulum. How far Foucault owed the success of this and his other discoveries to the influence of Bertrand may be judged from M. Lévy's own words. Nearly at the beginning of his (Bertrand's) career, when he was but a mere professor at the Lycée, he discovered Foucault, became attached to him, helped him with the mathematical science which Foucault was lacking, contributed thus to his discoveries without in any way thrusting himself forward; and afterwards, hardly had he been elected into the Academy of Sciences, before he pressed forward the candidature of the great physicist, then little known or unappreciated, against the opposition of many of the highest authorities of that time—a contest which has remained famous. The struggle was not without its risks, nor the success without its honour. One vote turned the scale. But the Institut de France added one more man of genius to its scientific roll.

By the end of 1883 Bertrand had written about 121 papers. Many of these were published in the *Comptes rendus*; others, mostly written in a lighter style and oftentimes with a vein of irony running through them, appeared in the *Revue des deux Mondes*, and included criticisms on "pseudo-mathematicians," as well as numerous biographies of genuine men of science.

Of late years Bertrand communicated but few papers to the Paris Academy. He appears to have devoted himself chiefly to the administrative work of the Academy. In connection with the annual awards of

prizes, we find his name almost invariably appearing on the lists of judges, and he appears to have been no less energetic in drawing up biographical notices of deceased members. Nevertheless, we find him in 1895 writing on a geometrical theorem, and in 1896 breaking a lance with Boltzmann on that ever-fascinating and never-satisfying theory, the Kinetic Theory of Gases. This is the last time that we have been able to find Bertrand's name in the *Comptes rendus* as the writer of a paper, though it repeatedly figures in other connections.

Bertrand's countenance and carriage are described as "characteristic." He was "short, thick-set, lively, vigorous, and very kind-looking. His face was covered with scars, and his nose had lost its bridge," as we have seen, as the result of the Meudon railway accident, but the imprint of misfortune would appear to have given a tender pathos to his appearance, which seemed to draw his friends nearer to him. As a relaxation from work, he is said to have never tired of reading the novels of Sir Walter Scott, whom he described as "the greatest



Joseph Bertrand.
(From *La Nature*.)

novelist that ever lived." He leaves several sons, one of whom, M. Marcel Bertrand, a mining engineer, is himself a member of the Academy of Sciences, and rather well known.

If Bertrand's mathematical work earned for him the respect and admiration of men of science far and wide, his philanthropy endeared him to the smaller circle with whom he was more intimately known. The enjoyment he derived from his own studies was fully equalled by his delight at reading the works of others. He constantly sought to bring to light fresh workers, and the few words of kind reassurance and appreciation, not to mention the passing on of an idea or the lending a helping hand over a difficulty, so much valued by the budding mathematician, were never wanting at the critical moment. In endeavouring to help those less favoured by fortune than himself, Bertrand would give much time and thought as to the best way of rendering them assistance. In 1857 Baron Thénard founded the "Société des Amis des Sciences," an institution the

object of which is to assist scientific men and their families when in need. Bertrand was one of the first to support the Society, and his signature figures along with those of Boussingault, Quatrefages, Becquerel, Sénarmont, Balard, Daubrée, Frémy, Deville, Berthelot and Pasteur in all its early records. In 1864 Bertrand was elected on the council, in May 1895 he was nominated vice-president, and in November of the same year he succeeded Pasteur as president. The Pasteur Institute also owes much to his energetic support.

Mathematical investigation is essentially a search for truth; but with Bertrand the love of truth and hatred of all that is false, was not confined to the mathematical side of his character; this trait was indeed deeply engrained into his whole existence. While there was nothing he would not do for those he knew to be deserving, he seems to have possessed a happy knack of effectually disposing of his enemies by a few strokes of sarcasm, which must have been the more withering because they so completely placed his adversaries in the wrong.

Had Joseph Bertrand's life and health been spared a little longer, there can be no doubt that he would have taken a foremost part in the liberal programme of congresses with which Paris hopes to attract a distinguished assembly of *savants* from all quarters of the globe, and we are sure that many English readers of his "Differential and Integral Calculus" would gladly have availed themselves of the opportunity of coming into personal contact with the well-known French mathematician. The loss of so prominent a figure in the Parisian world of science would at any time be deeply deplored, and his absence from the brilliant gatherings that are to be, only adds to our regret at losing one who has done much to simplify and popularise the study of mathematics.

At the funeral, discourses were delivered by M. Jules Lemaitre, director of the Académie Française; by M. Maurice Lévy, president of the Académie; by M. Berthelot, his fellow secretary of the Académie des Sciences; by M. Gaston Darboux, representing the Société des Amis des Sciences; by M. A. Cornu, representing the École Polytechnique; by M. Duclaux, director of the Institut Pasteur; by M. Gaston Paris, administrator of the Collège de France; and by M. Georges Perrot, director of the École Normale. In endeavouring to portray the life of a man of many and varied parts like Bertrand, we have largely drawn on the information contained in these orations, which are published in the *Comptes rendus*; but while it has thus been possible to enter into many of the details of Bertrand's life, his character as an individual can only be appreciated by reading separately the thoughts expressed by those who have known him intimately in his many capacities. Of these expressions, we can do no better than conclude with the words of M. Georges Perrot:—

"Il n'a pas été moins grand par le cœur que par l'esprit."

G. H. BRYAN.

NOTES.

WE notice with regret the announcement that the Duke of Argyll died on Tuesday morning, at the age of seventy-seven years. No definite arrangement has yet been made with regard to the funeral, but it is believed the interment will take place next week.

THE international conference for the protection of wild animals in Africa, announced last week, was opened at the Foreign Office on April 24, and was attended by plenipotentiaries of France, Germany, Great Britain, Congo Independent States, Italy, Portugal and Spain. Readers of *NATURE* hardly need to

be reminded that such a conference is of deep importance, and it is sincerely to be hoped that a definite plan of action will be decided upon as a result of its deliberations. A leader in Tuesday's *Times* directs attention to the necessity of an international agreement to restrain the extermination of many of the mammals, birds and fishes in Africa. It is useless to preserve wild animals in one part of Africa while they are killed off without restriction in neighbouring districts by people accredited as citizens of another European State. This is why an international agreement is sought for. It is needless to dwell upon the unnecessary slaughter of elephants, rhinoceroses, hippopotami, and the larger kinds of antelopes, elands, koodoos, sables and others since the Cape Colony, the Boer States, and the Rhodesian territories have been opened up to colonisation. Half a century ago, as the *Times* points out, the whole of South Africa below the Zambesi swarmed with antelopes and other game, including lions and leopards. Now, except in a few rare districts, there is nothing more of the kind to be found than in Hampshire or Devonshire. To remedy this state of things, the *Times* advocates the establishment of large reserves, like the Yellowstone Park in the United States, where wild animals can be allowed to live their natural life. It is easier to bring this to pass in Central Africa, where so much land is practically waste, than in countries where civilisation has made its way. The experiment has been tried, on a small scale, in many places, and with considerable success. In a narrow strip of forest country on the South Coast the Government of the Cape Colony preserves some herds of elephants. Mr. Rhodes has done much for the preservation of antelopes both on his property near Cape Town and in Rhodesia. There appears to be no reason why very large areas in Central Africa should not be set apart as refuges in which all the rich animal life of the continent might be permitted to propagate and develop under something approaching to natural conditions. Ten or twelve of these great reserves would keep alive, for a time at least, the striking types of animal life in which Africa is so extraordinarily fertile.

In connection with the subject of the foregoing note, some remarks made by Prof. S. P. Langley in the latest report of the Smithsonian Institution are of interest. It is pointed out that the National Zoological Park at Washington was established with the object of preserving the fast vanishing species of American animals. The changes which were noticed in the western part of America some years ago are now occurring in Alaska. With the advent of the settler and the railroad in the West, the great herds of animals which ranged over the western territory of the United States were practically exterminated, though by strenuous efforts here and there small collections of the buffalo and other large interesting mammals, like those in the National Zoological Park, have been kept alive. Whether a race can be made to survive in this way is open to question, but the effort at least should be made, and the Smithsonian Institution is trying to promote this survival. The United States still possesses at Kadiak Island, on the south-east coast of Alaska, a few living specimens of the largest carnivorous animal now in the world—a monster bear—which has not at any time been brought into captivity. Prof. Langley has been trying for two years, through American companies on the island, to obtain live specimens of this and other great mammals of Alaska with the hope of preserving the species before the inevitable opening of all that distant territory of the United States to civilisation and settlement will have resulted in the extermination of its large fauna, but these efforts have hitherto been wholly unsuccessful.

THE summer meeting of the Institution of Mechanical Engineers will be held in London during the last week in June.

THE Bruce gold medal of the Astronomical Society of the Pacific has been awarded to Dr. David Gill, C.B., F.R.S.

THE *Daily News* announces the death of Prof. A. Milne-Edwards, director of the Natural History Museum at Paris.

SIR J. BARRY TUKE, well-known for his works on mental diseases, has consented to become a candidate for the vacancy in the parliamentary representation of the Universities of Edinburgh and St. Andrews, caused by the death of Sir William Priestley.

WE learn from the *Chemical News* that an international banquet will be held by the Chemical Society of Paris in honour of those gentlemen who, by their presence at the Universal Exhibition, will represent pure and applied chemistry. The date fixed for the banquet is Thursday, July 19, when the chair will be taken by M. Berthelot, honorary president.

THE economic position of the German Empire in 1900 forms the subject of a report by Mr. Gastrell, commercial attaché to Her Majesty's Embassy at Berlin, which has been issued by the Foreign Office. It is instructive to trace the steps in the progress of the German Empire towards the important position it holds to-day. Mr. Gastrell points out that, in industrial and commercial matters, the first twenty years of the existence of the German Empire—from 1871 to 1890—were devoted to the elementary education of its people; the following ten years—1891 to 1900—have been spent on their higher education; and the end of the century sees in them a body of men each an expert in his own trade or profession. The bases on which Germany's power stands are primarily its trade and, in a minor degree, its agricultural resources. The population of Germany to-day is probably larger than that of the United Kingdom by some 15,000,000, and greater than that of France by about 17,000,000.

THE facilities which will be granted by the Portuguese Government to foreign astronomers visiting Portugal in May, for the purpose of viewing the total eclipse of the sun, have been made the subject of an official announcement by the Foreign Office. Astronomers from abroad will be exempt from payment of the usual Customs duties on production at the Custom House, on arrival, of a certificate drawn up by the astronomical society to which they may belong, setting forth their names, and describing the instruments and books which are to be imported. This certificate, however, should be legalised by the nearest Portuguese Consulate before starting. Further, it is announced that the Ministry of War has informed the Ministry of Education that all the military authorities of the districts of Vizen, Aveira, Guarda, Castello Branco and Coimbra will afford any possible assistance to astronomers during the observations, and that tents will be lent to observers, on a request being addressed to the Ministry of War in Lisbon to that effect. A Government notice has now been published in the *Official Gazette*, stating that the King has nominated a Royal Commission for the purpose of assisting in every way those who may come from abroad for scientific observations, and for superintending astronomical arrangements generally. This commission will sit either at the Royal Observatory, Lisbon, or at the Geographical Society, Lisbon; its president is his Excellency Senhor Marianno de Carvalho. If any British astronomers going to Portugal will communicate with her Majesty's Minister shortly before their arrival, he will be able to take steps to facilitate the object of their visit.

THE annual meeting of the Iron and Steel Institute will be held on Wednesday and Thursday, May 9 and 10, under the presidency of Sir William Roberts-Austen, K.C.B., F.R.S.

On the first day, the Bessemer gold medal for 1900 will be presented to Mr. Henri de Wendel, president of the Comité des Forges de France. During the meeting, papers will be read and discussed on ingots for gun tubes and propeller shafts; the manufacture and application of water-gas; the equalisation of the temperature of hot blast; blowing-engines driven by crude blast-furnace gas; the solution theory of iron; the use of fluid metal in the open-hearth furnace; the manganese ores of Brazil; the utilisation of blast-furnace slag; iron and phosphorus; and the continuous working of the open-hearth furnace. The annual dinner of the Institute will be held at the Hotel Cecil on May 9.

It may be remembered that in France, last year, the *Matin* organised a race of about 1400 miles, known as the "Tour de France," which effectually brought the powers of automobile vehicles to the notice of all sections of the population. In some of these contests very surprising results have been attained. The winning car in a recent race at Pau, says the *Times*, accomplished a distance of 208 miles without a stop, at an average speed of 44½ miles an hour, covering the first 34½ miles in the remarkable time of 33½ minutes. Stimulated by the success of last year's "Tour de France," both in promoting the use of motor cars and in revealing the types of car best suited for the purposes in view, the Automobile Club of Great Britain and France has arranged a trial of over 1000 miles, to be carried out on a route passing through the following centres of population:—Bristol, Birmingham, Manchester, Edinburgh, Newcastle-on-Tyne, Leeds and Sheffield. The procession of cars started from Hyde Park Corner on Monday, and the survivors will return to London on Saturday, May 12. Eleven days will be devoted to covering the distance, and at each of the above-named places the vehicles will be on exhibition for one clear day. They will also be exhibited for a few hours at Cheltenham, Kendal, Carlisle, York, Lincoln and Nottingham, and at the conclusion of the trial there will be a week's exhibition at Prince's Club, Knightsbridge. Over eighty vehicles are taking part in the trial, of which fifty-three have been entered by manufacturers and agents, and the remainder by private owners.

THE death is announced of Prof. Silas W. Holman, emeritus professor of physics at the Massachusetts Institute of Technology.

AN appreciative notice of the life and scientific career of the late Mr. J. J. Walker, F.R.S., who died on February 15, is contributed to the *University College School Magazine* by Mr. R. Tucker. Mr. Walker was appointed lecturer in applied mathematics and physics at the school in 1865, and in the same year became a member of the London Mathematical Society. He was a member of the council of the society from November 1869 to November 1874, and then again from November 1876 to November 1894; he was vice-president for two periods of two years, and president from November 1888 to November 1890. He contributed some twenty-four papers to the *Proceedings*, the longest of which were a method in the analysis of plane curves and on the satellite of a line relatively to a cubic. His presidential address was "On the influence of applied on the progress of pure mathematics." This, as remarked by his successor in office, Prof. Greenhill, "showed us how many of the most abstruse theories of pure analysis owe their origin to ideas which arose in connection with concrete and even practical requirements." His range of mathematical reading was very extensive, and he contributed papers to the Royal Society and most of the mathematical journals. From 1868 to 1882 Mr. Walker was vice-principal of University Hall. He was a member of the Physical Society, and was elected F.R.S. in 1883.

THE death of M. Gustave Planchon has removed from our midst perhaps the most active scientific pharmacist of the

present day. Although typically French, Planchon's works, so far as their matter is concerned, are cosmopolitan, his "Simple Drugs of Vegetable Origin," for instance, being known to all students of pharmacy. Planchon was a graduate of Montpellier, and the first part of his career was spent in teaching pharmacy in the Montpellier Faculty of Medicine. In 1866, however, he was called to Paris as Professor of the Natural History of Medicaments. He was appointed Director of the Paris School of Pharmacy in 1886, and continued to hold that position until his death a few days ago. Most prominent among his contributions to pharmacy are his, the work mentioned above, and, brochures upon quinine, ipecacuanha and jaborandi. He was also a great authority upon the history of pharmacy and medicinal plants lore. He was quite recently elected President of the International Congress of Pharmacy, which is to take place in Paris next August, and it will be a matter of most sincere regret that one who would have filled the duties of this position so ably has been so unexpectedly cut off. Besides those who admire his work, and him on account of it, he leaves behind a large circle of close friends who will all their lives miss his kindly personality.

THE Paris correspondent of the *Times* reports that a geologist, M. Neuburger, has just been examining, on behalf of the French Government, the mineral oil country of Oran, Algeria. It is stated that there is a tract, of at least 120 miles in length, exceedingly rich in petroleum, resembling the rich districts of Baku and Galicia.

THE death of an aeronaut at Paris from poisoning by hydrogen arsenide shows the necessity of taking precautions to purify the gas used for filling balloons. From a note in *La Nature* it appears that upon the occasion on which the accident occurred the balloon was filled in the ordinary way, and nothing peculiar was noticed in the character of the gas; but some hours afterwards the persons who had assisted in the operation were taken seriously ill, and one of them did not recover. The accident directs attention to a danger frequently overlooked.

ANOTHER effort to discover some clue to the fate of Andrée will be made this summer. The *National Geographic Magazine* states that the Swedish-Russian Expedition, which will leave about June 1 for Spitzbergen to relieve the party that is at present engaged in the work of measuring an arc of the meridian in that latitude, plans to make a detour to King Charles Land and carefully search the entire neighbourhood. It will be remembered that in September of last year a buoy was picked up on the north coast of King Charles Land, at 80° north latitude and 25° east longitude, marked "Andrée's Polar Expedition." When taken to Stockholm and opened, it proved to be what Andrée had called "the North Pole Buoy," and in which he was to place a message when he passed the North Pole. However, a microscopical examination of the interior could discover no message. As the buoy could not have drifted to King Charles Land from the neighbourhood of the Pole, the only conclusion possible is that it was a part of the wreckage of the expedition, and that possibly more wreckage may be found near by.

SWISS engineers, though so successful in the manufacture of various classes of machinery, labour under the disability that practically the whole of the iron employed, valued at over two million pounds annually, has to be imported from Germany and elsewhere. This is due, not so much to the absence of iron ores within their boundaries as to the want of coal wherewith to smelt it. We learn from the *Electrician* that recent researches in electro-metallurgy promise a means of overcoming the defect, and a scheme for the application of the electric furnace to the smelting of iron on the large scale is being

developed by Herr Müller Landsmann in the Bernese Oberland, near Meiringen. A concession has been obtained from the State for the working of an outcrop of hematite. The vein has a thickness of 7 feet, and is visible for a length of two miles along the mountain face. Thence the ore will be transported by an aerial ropeway to Innertkirchen below. The concession obtained for the water power available from the Aar in the immediate neighbourhood, amounting to 60,000 h.p., will be used to drive the machinery required, and to supply the power for the electric smelting furnaces.

AGRICULTURAL experiment promises to become an important branch of technical education in rural districts. Prof. W. Somerville's eighth annual report on experiments with crops and stock in the counties of Cumberland, Durham and Northumberland is an instance in point. It contains the results of well-arranged experiments of direct value to the farmers of the districts in which they were made; and by encouraging work of this kind the councils of the counties mentioned are doing a service both to technical education and the agricultural community. Many of the investigations described deal with the values of natural and artificial manures for different crops. A note on the eradication of charlock amongst corn crops by spraying with solutions of sulphates of copper and iron is of wide interest. The corn crop was in no case permanently injured by the treatment, though in some cases it was temporarily harmed. In no case was clover at all injured. On the whole, a 4 per cent. solution of copper sulphate is recommended for application at the rate of 25 to 40 gallons per acre, the dressing being repeated after the interval of a week if necessary.

At a meeting of the Academy of Science of St. Louis, on April 2, Dr. W. H. Warren read a paper giving an outline of recent progress in the chemistry of perfumes. For the most part, these substances are high boiling oils. Formerly these oils, which are complex mixtures of several compounds, were obtained exclusively from flowers, but recently some of the essential principles have been produced by chemical means, whereas other artificial perfumes are mere imitations. With a few exceptions, the essential principles which give the perfumes their value belong to the complex class of organic compounds known as the terpenes. Nearly every substance having the properties of a perfume has in its molecule certain atomic groups the presence of which exerts a marked influence on the odour. Among the more important of these may be mentioned the aldehyde, ketone, ester, ether and alcohol groups. Wonderful progress has been made in the knowledge of the terpenes and of their derivatives during the past ten or fifteen years, among the chemists who have taken a prominent part in the labour being Wallach, Baeyer and Tiemann.

PARTICULARS concerning the establishment of the Hamburg Institute for the study of nautical and tropical hygiene are given in the *Board of Trade Journal*. The Institute, like those of Liverpool and London, is a natural outgrowth of new conditions. The rapid transition from sails to steam, as a means of propulsion, the almost universal substitution of steel for wood in the construction of sea-going vessels, and the improvement in the food provided for seamen, have brought about a marked change alike in the ailments and the nature of the accidents occurring to members of the crews. Scurvy, night blindness, the so-called ship anæmia, chronic ailments of the digestive organs and canals, as well as lead-poisoning, even if not yet absolutely extinct, have become rare in a very marked degree. In their place, however, a series of new diseases has demanded the closest attention of the medical faculty. To deal with these diseases, and cases of malaria, beri-beri, black water fever, and other tropical disorders, special hospitals or institutes at large

ports are needed. The Hamburg Institute is to comprise a division for patients, provided with sixty beds and a laboratory, which will be fitted for bacteriological as well as for chemical research, space being provided for twelve investigators. Five tables for research will be reserved for qualified military medical aspirants for service with the German Colonial troops or under the German Colonial Department. Their course of study of the etiology, symptoms and treatment of malaria and other grave tropical diseases, of tropical physiology and tropical hygiene, will extend over several months. Attention will also be given to the more general methods of hygienic investigation, so that the students in question, when opportunity should be forthcoming, may possess the requisite training for extended research abroad, combined with the ability to report technically thereon. The additional tables in the laboratory will be placed at the disposal of the naval and mercantile services, as well as of medical men, who, having returned from the tropics, are desirous of pursuing special branches of research. The participation of Prof. Koch in the investigation of tropical diseases has greatly assisted the decision of the German authorities in establishing the Hamburg Institute.

THE complete history of the great Japanese earthquake of 1891 is still unwritten; but Prof. Omori has contributed an interesting note upon it to the last volume of the *Publications of the Earthquake Investigation Committee*. The total disturbed area is estimated at about 900,000 sq. km. The maximum acceleration at various places was calculated from a large number of overturned bodies; that at Nagoya being 2600, and at two other places more than 4300 km., per second. The range of the motion at Nagoya must have been about 233 km. Many observations were also made on the direction of overturned bodies, from which it appears that in and near the Mino-Owari plain, the principal direction of the earthquake motion was approximately normal to, and directed towards, the meizoseismal zone.

FOR several years Prof. Omori has studied the subject of earthquake measurement in a brick building. One of Prof. Ewing's horizontal pendulum seismographs was fixed near the top of an external wall of the Engineering College at Tokyo, whilst another was erected on the ground below. During the years 1894-98, ten moderate earthquakes were recorded, and it was found that if the earthquake consisted of comparatively slow vibrations (say, above half a second in duration), the motion was practically the same in both places; but if of quick-period vibrations, the motion of the top of the wall was about twice as great as that of the ground. Prof. Omori notices that, with destructive earthquakes, the damage of two-storied buildings is generally confined to the upper storey.

WE have received a reprint, from the *Transactions of the Royal Society of Canada*, of a note, by Mr. W. Bell Dawson, on some remarkable secondary tidal undulations registered at Halifax, N.S., Yarmouth, St. Paul Island, and St. John, N.B., on January 1 and 2 of this year. The secondary movements ranged from 10 per cent. of the whole amplitude of the tide at St. Paul Island, to no less than 45 per cent. at Yarmouth. The pilot chart of the North Atlantic shows that at least three storms, two of which developed hurricane force, passed over or near the region between December 26 and January 2. Mr. Dawson does not attack the general problem of the causes of secondary undulations, which are of very frequent occurrence off the eastern seaboard of Canada, but he draws attention to the favourable conditions which exist there for observing them. The most important feature as yet determined is that the secondary undulations do not become magnified in range in the same ratio as the main tidal undulation does, under the influence of the general form of the coast.

THE sudden rise of temperature over the British Islands towards the close of last week, when the temperature in the neighbourhood of London reached 78°, owing to the presence of a large area of high barometric pressure, was a very welcome change from the recent exceptionally cold period to which the lateness of the spring in all parts of the country was due. This reading has only been once exceeded in April during the last twenty-five years. For the greater part of the month the mean of all the highest day readings was about 1° below the average, and it was not until the 19th that the temperature at Greenwich exceeded 64°; in many recent years a higher temperature has occurred in March. The returns published by the Meteorological Office show that the rainfall over England since February had been much below the average, and that the amount of bright sunshine had been deficient in most parts.

TO the March number of the *Agricultural Gazette* of New South Wales, Mr. W. W. Froggart, the Government Entomologist, communicates an important paper on the "plague" of locusts to which the country has lately been subjected. Although Australia has been visited by swarms of locusts from a very early period, it does not appear that these did much damage till the seventies, when farms had begun to occupy much of the open plains of Victoria and other districts. Between that period and 1891 New South Wales was devastated by swarms of the species known as *Pachytelus australis*; but in the serious visitation of 1899 the place of that kind was taken by *Epacromia terminalis*, which is believed to have moved into the colony from South Australia. Not only did the swarms destroy all the sheep-feed in the districts visited, but they likewise ruined some 20,000 acres of young wheat. Mr. Froggart concludes that an effectual remedy would be either to destroy the eggs, or to expose them in such a manner that they would be readily accessible to the attacks of birds. But he has also hopes that inoculation of the immature insects with the so-called African locust-fungus would have good results.

THE March number of the *American Naturalist* contains some interesting remarks on the habits of the American gilled and blind salamander described some time ago by Dr. Stejneger under the name of *Typhlomolge*. A number of living specimens were obtained from subterranean waters at a depth of 181 feet below the surface, but only one of these survived for any length of time above ground. Unless disturbed, these salamanders spend their time in resting or in walking very slowly; when walking, they move a few steps at a time, pause awhile, and then once more advance. From the extreme slenderness of their limbs, Dr. Stejneger came to the conclusion that these were employed solely as feelers, and that progression was effected by means of the tail; but this conjecture is now shown to be incorrect.

FROM Mr. J. C. Thompson we have received a copy of his paper on tropical and northerly "plankton," published in the *Transactions* of the Liverpool Biological Society.

WE have to thank Messrs. Eigenmann and Schafer for a copy of their paper on the mosaic of single and twin cones in the retina of fishes, published in the February number of the *American Naturalist*.

THE *Irish Naturalist* for April contains an interesting account by Dr. R. F. Scharff upon all the species of whales and dolphins known to have visited the Irish coast, illustrated by good figures of their skulls, with the outline of the heads.

IN a paper on some abnormally-coloured Australian birds, in the *Victorian Naturalist*, Mr. R. Hall calls attention to the fact that while in New Zealand and South Australia birds display a tendency to albinism, in North Australia, as in India, the variation tends to the development of melanism.

HITHERTO the genus of vampire bats known as *Monophyllus* has been represented only by a single species from Jamaica. In a recent issue of the *Proceedings* of the Washington Academy of Sciences, Mr. G. S. Miller describes three new representatives of the genus, at least one of which is from the mainland.

THE *Journal* of the South-Eastern Agricultural College, Wye, Kent—issued under the joint auspices of the Kent and Surrey County Councils—contains much valuable information in regard to pests and diseases which infect or afflict cattle and crops; the one of most local interest being an essay on "red mould" in hops.

MONSIEUR C. JANET, President of the Zoological Society of France, has favoured us with a copy of his "Essai sur la constitution morphologique de la Tête de l'Insecte," Paris, 1899. In this brochure, which is admirably illustrated, the author adopts the view that the true head of all insects is primarily composed of five segments.

WE have received from the Trustees of the British Museum the portion of vol. ii. of the "Catalogue of the Lepidoptera Phalaenæ" containing the plates, by Sir George Hampson. The execution of the coloured illustrations of these "Microlepidoptera" is all that can be desired; but we notice that the author has departed from recognised usage in calling the family *Arctiidae* instead of *Arctiidae*.

THE "Psychological Index," published annually by the *Psychological Review*, is well-known to be a comprehensive and orderly bibliography of original publications in all languages, on psychology taken in its widest sense. The "Index" for 1899 has just been published, and it occupies no less than 174 pages of the *Psychological Review*.

ENGLER'S *Botanisches Jahrbuch für Systematik, Pflanzengeschichte, und Pflanzengeographie* continues to be characterised by the value and excellence of its papers in the domain of systematic botany. The parts most recently received (vol. xxvii. Heft 5 and vol. xxviii. Heft 2) contain, among other contributions, the conclusion of the Editor's series of papers on the flora of Africa; a paper on experiments on variation in plants, by Krasan; an exhaustive paper on the genus *Thea*, and the anatomical and morphological characters of the teas of commerce, by J. Kochs; a monograph of the genus *Mollinedia* (Monimiaceæ), by Janet R. Perkins.

THE report of the Epsom College Natural History Society reminds us that the study of natural objects and phenomena which the Board of Education is endeavouring to develop in rural schools, is already carried on in an admirable way by the boys in many of our public schools and colleges. We find in the present report abstracts of lectures, descriptions of work done in the astronomical, botanical, entomological, geological, photographic and zoological sections, a summary of meteorological observations, and tables of anthropological measurements of boys in the college. The lists of plants observed and dates of first blooms, of insect captures, and of the dates when various birds were seen, or their nest, eggs and young, are particularly interesting from the point of view of phenology. The evidence given by the report of interest in natural things and characteristics is gratifying to every lover of natural history, and a credit to Epsom College.

THE *Athenæum* makes the following announcement:—"The 'Diary of White of Selborne' is to be published. He kept it, as is well known, for more than twenty-five years, and used for the purpose a form 'invented' by Daines Barrington, entitled 'The Naturalists' Calendar,' constructed for recording on each day, in proper columns, the readings of the thermometer and barometer; the direction of the wind; the measurement of the

rainfall; the weather; the appearance of leaves and flowers of plants; the appearance or disappearance of birds and insects; observations with regard to fish and other animals; and miscellaneous observations. But Gilbert White enriched his "Calendar" with much other matter. There are not only numerous disquisitions on points of natural history, but notes of events of public interest and of personal or domestic concern. These are written on interleaves, or such spaces as may happen to be available. It is proposed to arrange for the publication of the diary in the manner of the original in every substantial particular. There will be no editorial notes, except in elucidation of a few points of real obscurity. It will fill two large quartos of about 700 pages each, and Messrs. Constable and Co. are to be the publishers.

In the current number of the *Bulletin de la Classe des Sciences* of the Royal Belgian Academy is a paper by M. Henry, on some new reactions of formaldehyde. Phosphorus pentachloride and pentabromide give methylene dichloride and dibromide respectively, the latter in so good a yield as to be an advantageous method of preparation. Formaldehyde also reacts readily with acetyl chloride to give chlormethyl acetate, acetyl bromide giving the corresponding bromine compound. The yields are better than those given by the interaction of the halogen and methyl acetate.

THE same number of the *Bulletin* contains an exhaustive study, by M. Gillot, of the hydrolysis of raffinose by *Penicillium glaucum*. In solutions containing a mineral acid the mould is able to secrete a yamase capable of inverting raffinose, and this ferment is still produced, although more slowly, when the solution is neutral. In alkaline solutions the germination of the spores is retarded, the solution losing its alkalinity as the development of the mould proceeded, finally becoming acid. The yamase from a pure culture of the *Penicillium* was isolated, and raffinose inverted by its aid.

THE additions to the Zoological Society's Gardens during the past week include a — Baboon (*Cynocephalus*, sp. inc.) from Zanzibar, a Suricate (*Suricata tetradactyla*) from South Africa, a Common Boa (*Boa constrictor*), an Anaconda (*Eunectes murinus*) from South America, a Pin-tailed Sand-Grouse (*Pterocles alchata*), South European, deposited; a Panolia Deer (*Cervus eldi*, ♀) from Burmah, five Common Wigeon (*Marca penelope*), three Pochards (*Fuligula ferina*), three Tufted Ducks (*Fuligula cristata*), four Goldeneyes (*Clangula glaucion*), European; a Common Boa (*Boa constrictor*) from South America, purchased; a Barbary Wild Sheep (*Ovis tragelaphus*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN MAY.

- May 1. 8h. 38m. to 9h. 48m. ♄ Tauri (mag. 4.7) occulted by the moon.
- 1-6. Epoch of the Aquarid meteoric shower (radiant $338^{\circ}-2^{\circ}$).
2. 5h. Venus in conjunction with moon. Venus $4^{\circ} 55' N$.
5. 11h. 48m. to 12h. 42m. ♄ Cancri (mag. 5.6) occulted by the moon.
6. 11h. 1m. to 11h. 51m. ♄ Leonis (mag. 5.6) occulted by the moon.
7. 10h. 43m. to 11h. 49m. 19 Sextantis (mag. 6.0) occulted by the moon.
15. Venus. Illuminated portion of disc, 0.402; Mars, 0.975.
22. 10h. 8.7m. Jupiter's Sat. IV. in conjunction N. of the planet.
27. 7h. Jupiter in opposition to the sun.
28. Total eclipse of the sun, partially visible at Greenwich.

NO. 1591, VOL. 61]

Times of Occurrence and Magnitude for places in the British Isles.

Place.	Eclipse begins. h. m.	Middle of eclipse. h. m.	Eclipse ends. h. m.	Magnitude.
Greenwich ...	2 47.0	3 54.9	4 57.5	0.681
Cambridge ...	2 46.7	3 53.9	4 56.0	0.664
Oxford ...	2 45.3	3 53.6	4 56.7	0.683
Liverpool ...	2 42.1	3 49.9	4 52.9	0.685
Edinburgh ...	2 40.8	3 46.1	4 47.4	0.553
Dublin ...	2 37.9	3 47.4	4 52.0	0.676

This is the largest solar eclipse visible in England since that of 1870 December 22, when about eight-tenths of the sun were obscured.

31. 18h. Venus at her greatest brilliancy.

PHOTOGRAPHS OF THE AURORA SPECTRUM.—M. Paulsen describes in *Comptes rendus*, cxxx. pp. 655-656, 1900, his successful attempts to obtain a photographic record of the spectrum of the aurora borealis. His station was in Iceland, where he states the displays were very vivid during the period December 31, 1899, to January 25, 1900, and photographs were obtained with two spectrographs, one having a quartz train for recording especially the ultra-violet, the second with glass components. In all twenty-two lines have been recorded, of which sixteen are new. Their wave-lengths have been provisionally determined by means of comparison photographs of the spectra of air and metals, and are as follows:—

Strong lines : 337, 358, 391, 420.
Faint lines : 353, 371, 376, 381, 393, 397, 402, 406, 412, 417, 422, 432, 436, 443, 449, 456, 463, 470.

The four strong lines were obtained from even feeble streamers, but for the others it was necessary to keep the spectroscope in the brightest regions. Besides the lines given, several others can be seen between $\lambda\lambda$ 357 and 250, but are too feeble for reduction.

NEW VARIABLE STAR IN TAURUS.—Dr. Anderson, of Edinburgh, announces in the *Astronomische Nachrichten* (Bd. 152, No. 3634), that he has detected variability in the star having the following position for 1855:—

R. A. = 5h. 44.1m.
Decl. = $+15^{\circ} 45'$.

This star is not in the B.D., and some years ago he found it about magnitude 9.25, while on 1899 November 8 it was invisible in a 3-inch refractor, which plainly showed a neighbouring star of 11 mag. On 1900 March 26 it was about 9.7 mag.

NEW VARIABLE IN CASSIOPEIA.—In the *Astronomische Nachrichten* (No. 3634), Dr. Anderson also announces the variability of a star in Cassiopeia, whose position for 1855 is

R. A. = 23h. 48.4m.
Decl. = $+52^{\circ} 55'$.

On 1900 February 10 the star was 9.6 mag.; but on March 17 and 25 it was less than 10.5 mag.

FORMULA FOR ATMOSPHERIC REFRACTION.—In the *Comptes rendus* (vol. cxxx. pp. 1060-1061, 1900), M. L. Cruls gives a simple formula for calculating the astronomical atmospheric refraction, which is found to give results very closely in agreement with those calculated from Laplace's formula.

The equation is

$$R = (60'' \tan z - 1'' \tan^2 z) \left(0.00138B - 0.00001 \frac{Bt}{z} \right),$$

in which R is the refraction, z the zenith distance of the object, B the barometric pressure, and t the temperature in degrees Centigrade at the time of observation.

A table of comparisons is given, showing that the difference in the refraction, as obtained from the above formula and that of Laplace, is only 0.2 at 10° zenith distance, the error gradually increasing as the horizon is approached; but even at 70° zenith distance the two formulae give results differing only by 1.6" of arc.

DETERMINATION OF AXIS AND COMPRESSION OF NEPTUNE.—The *Astronomical Journal*, No. 479 (vol. xx. pp. 181-185), contains an article by Prof. S. J. Brown, of the U.S. Naval Observatory, on the determination of the position of Neptune's axis, and the degree of its polar compression from an investigation of the perturbations of the orbit of its satellite. Eighteen

determinations of the orbit of the satellite to this planet have been made during the period 1848-1898, but, owing to the position of the planet and the plane of the orbit, many of the earlier observations are very discordant, and it was only on publication of the results obtained with the 26-inch at Washington that the certainty of change in the position of the orbit plane was manifest (*Washington Observations*, 1873, 1881, Appendix i.). Marth first drew attention to the changes as being too great for systematic errors, but attempted no explanation as to their cause (*Monthly Notices*, vol. xvi. p. 504), and finally Tisserand used his data to show that the phenomenon could be explained by the assumption of a moderate polar compression of the planet (*Comptes rendus*, vol. cvii. p. 804). In calculating the perturbation Prof. Brown neglects the action of the sun and other planets, as the chief effect is undoubtedly due to the equatorial protuberance on Neptune itself. He therefore analytically obtains the elements of the satellite's orbit with respect to the invariable plane of the planet's equator, along which the node of the former moves with a uniform retrograde motion, the inclination of the two planes remaining constant.

The variations of these elements at the various epochs then furnish data for computing the annual motion of the node of the orbit of the satellite on the equator of Neptune as seen from the earth. The elements finally obtained indicate a period of revolution of the node in 531 years. At the epoch 1900 the position angle of Neptune's polar axis will be $158^{\circ}4$, and the plane of its equator will make an angle of $-21^{\circ}6$ to the line of sight.

Taking the value $1''10$ as the most probable radius of the planet from recent observations, and the mean distance of the satellite as $16''308$, the flattening of Neptune is found to be about $1/43$. This would indicate a low mean density for the planet, the value given being 1.83 times that of water.

THE RELATIONS BETWEEN ELECTRICITY AND ENGINEERING.¹

THE nineteenth century is distinguished in our profession chiefly by the knowledge we have obtained of the constitution of matter and of the qualities of the materials we utilise for the service of man, of the presence and the characteristics of that medium—the aether—which fills all space, and of the existence, indestructibility and protean character of that great natural source of force, motion, work and power which we call—energy.

Electricity is only one of many forms of this energy. It is measurable in well-defined and accurately-determined units. It is produced and sold, utilised and wasted. It is, therefore, something distinctly objective. It has even been defined by Act of Parliament. There are four great principles underlying the practical applications of electricity:—

- (1) The establishment of a magnetic field.
- (2) The establishment of an electric field.
- (3) The disturbance or undulation of the aether.
- (4) The work done by the generation and maintenance of electric currents in material systems.

Electricity as a science is fascinating to every one, but it is deeply fascinating to the engineer. The trustworthiness of its laws, the accuracy of its measurements, and the completeness and definiteness of the units to which its measurements are referred give him confidence in his estimates and a certainty of the performance of his preconcerted operations. It places in his hands the means of directing the energy out of sight in positions known only to himself, and of applying it with great efficiency at the exact spot desired. No magician or poet ever conceived so potent a power within the easy reach of man.

The Doing of Work.

The maintenance of an electric current through a conductor means the expenditure of work upon that conductor, and this expenditure of internal work means molecular motion. In solid conductors the result is heat. If the current be gradually increased, this motion is similarly increased. The result is successively incandescence, white heat, fusion and disruption.

¹ Abridged from the "James Forrest" Lecture delivered at the Institution of Civil Engineers, on April 23, by Sir William Henry Preece, K.C.B., F.R.S.

In liquid conductors the motion probably becomes revolution. The result is decomposition by the activity of the centrifugal force overcoming chemical affinity. The atoms fly away in fixed determined lines, and collect at opposite poles.

In gases the transference of electric energy in the form of sparks means dissociation. Compound gases are broken up into their component elements under the same directing influences. Work is done upon the gas as in the previous instances.

The principle of work that lies at the very root of the profession of the engineer enables all these operations to be measured in definite mechanical units, reducible to the common English standard, the foot-pound, but which the electrical engineer, with greater precision, refers to the scientific unit of work—the joule.

The Purification of Matter.

The elements and their useful compounds are rarely, if ever, found pure. Impurities have to be sifted away. Ores, raw produce, rocks and earths have to be subjected to various processes of refining and conversion to extract from them that which is wanted. The electric current by the above operations has proved to be a powerful agent to break up crude materials into their useful and useless constituents. The electro-chemical industries of the world are very extensive.

According to Prof. Borchers, the eminent electro-metallurgist, the world manufacture of calcium carbide for the production of acetylene gas is utilising a power equal to 180,000 HP.; that of the alkalis and the combinations of chlorine for bleaching, 56,000 HP.; of aluminium, 27,000 HP.; of copper, 11,000 HP.; of carborundum, 2600 HP.; and of gold, 455 HP. Electroplating is one of the staple manufactures of Sheffield and of Birmingham. There are nearly 200 firms working at the former place, and over 100 at the latter.

The decomposing bath and the arc furnace are revolutionising many industries. Phosphorus is now being produced in England in large quantities from corundum, and aluminium from bauxite is extending in use and being reduced in price. The Post Office is using aluminium for telephone circuits. I have recommended its use on a very large scale in the interior of Africa, where transport is so costly. We can get the same conductivity as with copper with half the weight, and at a less price, and we can put up a line telegraphically ten times better than of iron for less money.

The Annihilation of Space.

The elements of Volta and the battery of Galvani—zinc, copper and a solution of sulphuric acid—gave a convenient generator of electric currents which could be directed along wires to great distances, and thus, by establishing magnetic fields, could deflect needles in such a way as to form the alphabet and so transmit words and, therefore, thought. In wires of great length, while the initial speed is that of light, it takes time for the electric waves to rise and fall, so that the number of currents which can be sent per second is limited. Between London and Liverpool the speed of speaking is virtually unlimited, but between Ireland and America it is restricted by the so-called capacity of the cable submerged in the ocean. This capacity absorbs energy and retards the rate of rise and fall of currents. While a thousand currents per second can be sent in the former case, only six per second are available in the latter.

Nevertheless, sitting on the shore of the Atlantic in Ireland, one can manipulate a magnetic field in Newfoundland so as to record simultaneously on paper in conventional characters slowly written words. Thus we have bridged the ocean and annihilated space.

The regulation of the ever-growing traffic on our railways and the safety of passengers is secured by similar means. The telegraph not only places the manager of the line in communication with every station upon his system, but electric signals control the motion of every train. A railway signal-box is an electrical exhibition. Every line is protected by its own electric signal. Every distant outdoor mechanical signal is repeated back. The danger signal is locked, and cannot be lowered to "line clear" until it is unlocked by the train itself or by the distant signalman. Mr. F. W. Webb is not only working the outdoor signals themselves by electrical energy, but he is moving the points and switches by the same means. So far, the experience gained at Crewe during a period of about twelve months, from the working of a signal cabin containing about sixty levers, has been such as to justify confidence and the extension of the system, and some

ten cabins containing about 1000 levers will be provided. The apparatus has been designed to work in with, as far as possible, the standard signalling apparatus of the London and North-Western Railway. The interlocking frame may be said to be the ordinary mechanical frame in miniature, occupying one-third of the space. The levers—about 6 inches in length—are placed in two tiers, and are manipulated in the same way as the levers of a mechanical frame; consequently the signalman accustomed to the old type has nothing to learn in the new. The levers are mechanically locked by means of tappet locking, and they control carbon switches by which the 110-volt electric current is transmitted to the motors.

The object of this electric working is primarily to reduce the manual labour of the signalman, and enable him to pay more attention to the movements outside his cabin; increased speed of working; the removal of obstructions on the ground caused by the numerous wire and rod connections necessitated by the present system; and, finally, a reduction in the number of signalmen employed. Thus electricity adds to the security of life. It supplies the railway man with a new sense, and the engineer with a new power.

The abridgment of time necessarily follows from the annihilation of space, but the chief element which saves our time so much is the fact that we can, by electricity, do so much more from one spot. Indeed, in the United States the railway companies complained that their revenue between New York and Chicago suffered through the introduction of the telephone. People remained at home and did their business by wire.

It is very curious when visiting the United States to find that their morning papers contain extracts from our London evening papers of the same day. One frequently receives messages in England that were sent off to-morrow. This is due to the difference of longitude.

Wireless telegraphy, or, as it is better termed, ætheric telegraphy, has made but small progress, owing to the simple fact that the demands for its services are so very few.

Transmission of Power.

The sun is the *fons et origo* of all the available energy upon the surface of the earth. Coal and oil are extracted from its crust; oxygen is found in its atmosphere. Grasses, corn, fruits and vegetables become food and fuel for beast and man. Waters are converted into vapour, forming clouds, rain, brooks, rivers, torrents and falls. The atmosphere is disturbed by wind, and the waters of the ocean by tides. Energy is thus found available for useful work in many different forms. The problem before the engineer is how to select the best form of energy for his purpose, and how to utilise these waste energies of Nature so as to secure the best economical result. Falling water can, by a turbine or impulse wheel, convert the energy it possesses in virtue of its fall into the form of electricity. By the aid of transformers it can be raised to very high voltages; 40,000 volts is employed in California, 11,000 in Niagara. We use 10,000 between Deptford and Trafalgar Square. It can thus be transmitted to any reasonable distance, and there it can be utilised to do useful work. The waste forces of Nature are thus within our reach. The waterfalls of the Highlands may work the tramways of Glasgow; Niagara already works those of Baltimore.

The economy of this system for large industries is a question of the relative cost of the generation of energy by other means. Energy on the coal-fields can be produced cheaper by burning coal than by any water scheme that I have yet examined in this country. The price and abundance of coal renders the transmission of energy to great distances at present a very limited question indeed. Where coal is scarce and dear and water abundant, as in Switzerland, water-power is very much utilised. Where coal is abundant and cheap, as in England, it is uneconomical to adopt it. The transmission of power within limited areas by electricity in our cities is now within the range of practice. In Edinburgh it is supplied at the rate 1½d. per unit; this is 0·83d. per HP.-hour. It is invaluable for small industries. It is there ready to be used when it is wanted; it wastes nothing while idle.

The economy and efficiency of distributing power over mills, factories and workshops by electricity instead of by shafting, gearing and belts, is so pronounced that the change is being effected in every country with great rapidity. If it were a question of the mere efficiency of the two systems, the advantage of the change would not be so obvious; but it is shown by the HP.-hours expended, which means the coal bill. The efficiency

of an electrical system is rarely less than 75 per cent., while that of shafting is frequently as low as 25 per cent.; but the economy is the continuous waste of the latter that tells on the coal bill, while in the electrical system there is no such waste. The motor runs when it is wanted, and expends only what energy is wanted for the particular work to be done. Electrical measurements are so exact and so easily applied that automatic records can be obtained of the work done by each machine.

Every up-to-date shop should have its electric plant for healthy light, cheap power and handy distribution of material. Its economy is demonstrable in the smallest, but in the largest shops it is at once most marked. It is always available, and it costs little. Ignorance or timidity restricts its use very much. The number of works that are run by electric motors in different parts of the country is very large indeed. The efficiency, handiness and economy of doing so is so marked that the practice is extending with great rapidity. Motors themselves are being daily improved.

On the Clyde and the Tyne, and indeed wherever shipbuilding is flourishing, there we find electrical energy driving machine tools, holding up plates, and assisting in various processes. In many large machine works, cranes and travellers are worked by it.

At Boston, U.S.A., crossing the Charles River and uniting Charlestown, the scene of the famous battle of Bunker's Hill, with its head-quarters, is a new bridge 100 feet wide and 1920 feet long, having a draw of 240 feet span, weighing 1200 tons. This draw is opened and closed by electric motors.

In the Post Office we have introduced electric motors very largely. At Leeds they are used for driving pneumatic pressure and vacuum pumps, employed there to work the pneumatic tube system. They are also used for working automatic stokers, ventilating fans and lifts.

Traction.

It is for traction purposes that electricity is making such gigantic strides. In the United States tramway working by its means has become practically universal. In the United Kingdom it is making rapid way, and in connection with electric lighting it is giving great economical results.

Electric railways are also growing apace. A bold attempt is being made by the Metropolitan Railway to work the existing line in such a way as not to interfere with the existing traffic or even with the permanent way. A new train of six coaches weighing 180 tons, having a motor car at each end weighing 54 tons, is about to run between Earl's Court and High Street, Kensington. Electric traction has an immense advantage over steam traction in impressing a continuous and uniform torque or turning moment on the shaft, and consequently a continuous and uniform effort on the trend of the wheel. The action of the steam locomotive is intermittent and the bite not continuous. Hence such frequent slipping on greasy rails. Again, the maximum torque can at once be applied by the current, and in combination with the constant effort it increases the acceleration so that a train acquires its maximum speed much more quickly. We shall increase the mean speed of the Metropolitan trains from 11 miles per hour to 15, and thereby increase the capacity of the line over 30 per cent. The stoppages on the underground railways are so frequent that the trains are always either accelerating or stopping. They never reach their top speed as they do on main lines. Electric traction enables them to start quicker and stop more promptly. On the Metropolitan the 180-ton train acquired 20 miles an hour in 200 feet, and, when going at the same speed, it was stopped in 130 feet—half its length. Smart work on such a railway depends on the rate at which trains can be emptied and filled. The English system of compartments and side doors facilitates this. It would be still further expedited if we could have one platform for entry and one for exit, and one class only.

The Liverpool and Manchester Lightning Express Railway, promoted by a very powerful representative syndicate of those two great commercial centres to carry out the scheme of Mr. Behr, is a very bold and promising venture. The line is to be monorail, 34 miles long, direct between the two cities, without any intermediate station and with no crossing. There are to be cars every 10 minutes. The speed is to be 100 miles per hour, and the time of transit 20 minutes. I know of no reason why this should not be done with safety and comfort.

The automobile car of the future has not yet seen the light. It will be electrical. Immense progress has been made in motors and in batteries. Lundell has shown how to store up the energy now wasted in descending hills, and to recover some

of that absorbed by the inertia of the car. Although a battery has already been able to drive a car 100 miles with one charge, we are waiting patiently for the real automotor storage cell.

Electricity in War.

A strong contingent of electrical engineers, under the command of Major Crompton, has volunteered for service in South Africa. They are all scientifically-trained practical young engineers. Bicycles, field telegraphs, telephones, arc and glow-lamps, cables, search-lights, traction-engines and generating plant will be under their care. It is strongly hoped that we may soon hear good accounts of their performances at the front.

Electricity has been extensively applied to the development and utilisation of explosives in both the civil and military divisions of our profession. Charges are safely fired under water and blasted in mining and demolition operations by small exploding dynamos, magnetic-electric machines or induction coils acting upon high tension fuses. Sir Frederick Abel has especially distinguished himself in this direction. His fuse, composed of phosphoride and subsulphide of copper, is universally used by our War Department. Time guns are thus fired at stated hours at different sea-ports by currents originating in Greenwich Observatory. Broadships in battleships and guns in turrets are similarly discharged. Torpedoes are even directed by currents from the shore. The defence of our coasts by submarine mines and their explosion by currents when the enemy's ships are properly located by position-finders is the last development of the application of electricity to war.

Electrical blasting has revolutionised the operations of tunnelling and driving galleries. It is much used in quarrying with great security to the men. The deepening of harbours and channels, and the removal of obstructions such as wrecks and rocks, are facilitated. On September 23, 1876, 63,135 cubic yards of solid rock were completely demolished by one discharge at Hell Gate in East River, New York. The preparation for this great blast took four years and four months. There were 4427 charged holes, each containing its mercury fulminate fuse and charges of dynamite. There were 49,914 explosions used in that one blast. Batteries were used to generate the currents, and they were arranged in large groups. Each battery exploded 160 charges. This was the record blast.

The battleship is the home of electricity. It controls the rudder, it ventilates the interior and the living space of the ship, it forces the draught and assists the raising of steam, it revolves the turrets, it trains and controls the fans, it handles the ammunition, it purifies the drinking water, it lights up the ship internally, it enables the captain to sweep the horizon with the brilliant rays of the search-light, and to communicate with his tender or with his commanding officer across space independent of weather, night, season, fog or rain.

Sanitation.

No branch of our profession fulfils the true function of the engineer more efficiently than that which deals with sanitation. Pure air, pure water, pure food, pure soil, pure dwellings, and pure bodies are the panacea for health and comfort. Electricity helps us very much in attaining some of these qualities. An electric glow-lamp does not vitiate the air. It does not throw into circulation in the air any product of combustion. The question of ventilation is very much reduced in importance and rendered more simple to effect. Much less air need pass through our sitting-rooms and meeting-places. The air vitiated by our lungs can be easily withdrawn and fresh air can be forced in by fans worked by electric motors. Even the air during its entrance can be warmed, and impurities floating in it can be sifted out of it by the attraction of electrification. Heating by Dowsing's luminous electric radiators is very much on the increase; they consume 250 watts, which cost about a halfpenny per hour. In many post-offices sealing-wax is melted and kept in a liquid state by currents. Water can be sterilised by ozone, a product of electrification, and even by the nascent oxygen, when broken up into its constituent elements by electric currents. Sea-water thus electrolysed supplies us with chlorine, and converts the water into a powerful antiseptic, disinfectant and deodoriser.

Weaving.

The applications of electricity to other industrial processes are innumerable. I have time to mention only one. Mr. T. A. B. Carver has brought out a new Jacquard loom for weaving; 600

hooks are controlled electrically. The twill as well as the pattern is under complete management. It has been warmly taken up in Glasgow, and a factory has been started there.

The pattern on this cloth is woven directly from a photograph of the artist's design, mounted on a metallic sheet; the threads of the warp being picked up by electromagnetic action, owing to the figure of the pattern being cut away, and thus allowing the circuit to be completed by the metallic sheet.

Distinction between Physicists and Engineers.

There is now a distinct line of demarcation separating the physicist from the engineer. The former dives into the unknown to discover new truths; the latter applies the known to the service of man. Research is the function of the one; utility that of the other. In the past the engineer had to rely on himself for his facts, but the advance of modern science, the growth of technical education, the formation of laboratories, and the endowment of chairs have changed all that.

We can scarcely hope for new sources of energy to be discovered, but there are some existing ones we have not touched yet. When the evil day arrives for our coal supplies to give out we may perhaps be able by the aid of electricity to utilise the heat of the sun and the tides of the ocean. There is, however, a vast illimitable store of energy not only in the rotation of the earth upon its axis, but in the internal heat of this globe itself. As we descend, the temperature gets higher and higher. It ought not to be difficult to reach such temperatures that by thermo-electric appliances we might convert the lost energy of the earth's interior into some useful electric form.

*THE SIGNIFICANCE OF THE INCREASED SIZE OF THE CEREBRUM IN RECENT AS COMPARED WITH EXTINCT MAMMALIA.*¹

IT has occurred to me that in order, at short notice, to take part in the celebration of the Biological Society of Paris—however briefly—I might place before my colleagues a biological problem and suggest a solution of it which, though not decisive, has, I think, much in its favour, and raises many interesting points for observation and discussion. It is well established that the extinct Mammalia of the Middle and Lower Tertiary had—as compared with their nearest living congeners—an extremely small cerebrum. The exact figures are not important, but Titanotherium—a true Rhinoceros—had certainly not more than one-fifth of the cerebral nervous substance which is possessed by living Rhinoceros. Dinoceras representing a distinct group of Ungulata had even a smaller brain. Yet in bulk these animals were as large as, or larger than, the largest living Rhinoceros. Further, it appears from the examination of the cranial cavities of extinct and recent Reptiles, that the increase in the size of cerebrum is not peculiar to Mammalia, but that we may assert as a general proposition that recent forms have a greatly increased bulk of cerebrum as compared with their early Tertiary or mesozoic fore-bears.

It appears also that the relative size of the cerebrum in man and the anthropoid apes may be cited here as a similar phenomenon; the more recent genus *Homo* having an immensely increased mass of cerebral nerve-tissue as compared with the more ancient pithecoid genera.

The significance of this striking fact—viz. that recent forms have a cerebral mass greatly larger than that of extinct forms (probably in every class of the animal kingdom)—has not been discussed or considered as it deserves. We cannot suppose that the extinct Rhinoceros, Titanotherium, was really defective in the essential control of its organisation by the cerebral nerve-centres. Probably could we see the two creatures alive side by side, we should not detect any defect in the manifestations of the nervous system in Titanotherium as compared with Rhinoceros; just as we do not remark any such obvious inferiority when we compare a lizard and (let us say) a mouse. The organism with the lesser cerebrum is in each case, in spite of the smaller mass of cerebral nerve-tissue, an efficient and adequate piece of living mechanism.

In what then does the advantage of a larger cerebral mass consist? What is it that the more recent Mammalia have

¹ By Prof. E. Ray Lankester, F.R.S. Reprinted from the "Jubilee Volume of the Société de Biologie de Paris, 1899."

gained by their larger brains? Why has there been this selection in all lines of animal descent of increased cerebral tissue?

I think we gain a key to the answer to this question by a consideration of the differences of cerebral quality between man and apes. Man is born with fewer ready-made tricks of the nerve centres—those performances of an inherited nervous mechanism so often called by the ill-defined term “instincts”—than are the monkeys or any other animal. Correlated with this absence of inherited ready-made mechanism, man has a greater capacity for developing in the course of his individual growth similar nervous mechanisms (similar to but not identical with those of “instinct”) than any other animal. He has a greater capacity for “learning” and storing his individual experience, so as to take the place of the more general inherited brain-mechanisms of lower mammals. Obviously such brain-mechanisms as the individual thus develops (habits, judgments, &c.) are of greater value in the struggle for existence than are the less specially-fitted instinctive in-born mechanisms of a race, species or genus. The power of being educated—“educability” as we may term it—is what man possesses in excess as compared with the apes. I think we are justified in forming the hypothesis that it is this “educability” which is the correlative of the increased size of the cerebrum. If this hypothesis be correct—then we may conclude that in all classes of Vertebrata and even in many Invertebrata—there is and has been a continual tendency to substitute “educability” for mere inherited brain-mechanisms or instincts, and that this requires increased volume of cerebral substance. A mere spoonful of cerebral tissue is sufficient to carry abundant and highly efficient instinctive mechanisms from generation to generation; but for the more valuable capacity of elaborating new brain-mechanisms in the individual as the result of the individual's experience of surrounding conditions, a very much larger volume of cerebral tissue is needed.

Thus it seems probable that “educability” has increased in those Mammalia which have survived. The ancient forms with small brains though excellent “automata” had to give place, by natural selection in the struggle for existence, to the gradually increasing brains with their greater power of mental adaptation to the changing and varied conditions of life: until in man an organism has been developed which, though differing but little in bodily structure from the monkey, has an amount of cerebral tissue and a capacity for education which indicates an enormous period of gradual development during which, not the general structure, but the organ of “educability,” the cerebrum, was almost solely the objective of selection.

Two lines of speculation and inquiry are strongly affected by the hypothesis thus sketched.

Firstly, as to the general laws of progressive development of bodily structure by the operation of natural selection—is it not probable that in various groups of animals, just as in the case of man among the Primates, the operation of natural selection on bodily structure (limbs, teeth, hair, horns, &c.) must have been checked, or even altogether suspended, by the transference of selection to the all-important organ of educability, the cerebrum or corresponding nerve-centres? Adaptation by means of the mental powers must take the place of adaptation of bodily structures. The educable animal leaves the ground and learns to climb trees in order to gain its food, whilst in another race the slower process of alteration of bodily form is evolving a long neck to reach the green twigs, or a ponderous strength of limb which can pull trees to the ground. Many similar cases will suggest themselves to the reader in which, even in lower animals, the capacity of learning by experience must (as it were) defeat and turn from its route the otherwise triumphant transformation of bodily structure.

Secondly, the question of the transmission of acquired characters is largely touched by these speculations. The character which we describe as “educability” can be transmitted, it is a congenital character. But the results of education can not be transmitted. In each generation they have to be acquired afresh, and with increased “educability” they are more readily acquired and a larger variety of them. On the other hand, the nerve-mechanisms of instincts are transmitted, and owe their inferiority as compared with the results of education to the very fact that they are not acquired by the individual in relation to his particular needs, but have arisen by selection of congenital variation in a long series of preceding generations.

To a large extent the two series of brain-mechanisms, the “instinctive” and the “individually acquired,” are in opposition

to one another. Congenital brain-mechanisms may prevent the education of the brain and the development of new mechanisms specially fitted to the special conditions of life. To the educable animal—the less there is of specialised mechanism transmitted by heredity, the better. The loss of instinct is what permits and necessitates the education of the receptive brain.

We are thus led to view that it is hardly possible for a theory to be further from the truth than that espoused by George H. Lewes and adopted by George Romanes, namely that instincts are due to “lapsed” intelligence. The fact is that there is no community between the mechanisms of instinct and the mechanisms of intelligence, and that the latter are later in the history of the development of the brain than the former, and can only develop in proportion as the former become feeble and defective.

These few lines—for the abruptness of which I apologise—will, I trust, serve to show the interesting nature of the speculations connected with the significance of the size of the cerebrum in various Mammalia and other animals. Some of the suggestions obtained from a consideration of the subject will, if carried out in detail, be found of first-rate importance in building up the science of comparative psychology.

ZONES IN THE CHALK.

THE philosophical observations on the genus *Micraster*, which were communicated by Dr. A. W. Rowe to the Geological Society in 1899, have been followed by the publication of his special researches on the zones of the white chalk on the coasts of Kent and Sussex. This second most valuable essay has been communicated to the Geologists' Association (*Proceedings*, vol. xvi. March 1900), who are to be congratulated on having such an addition to their published works. The paper follows along the lines so ably sketched out more than twenty years ago by Dr. Barrois; and Dr. Rowe, in nearly all cases, confirms the previous zonal distinctions and largely increases our knowledge. He shows how invaluable it is to collect stage by stage, and to pay the closest attention to the minute changes which the fossils, and particularly the *Micrasters*, undergo. The paper is essentially a zoological one, invaluable in indicating the succession of life, and as a contribution towards the genesis of species.

The ordinary subdivisions of lower, middle and upper chalk, which are important when we deal with purely geological problems, are not here dealt with; but the author, who apparently takes little interest in stratigraphy apart from fossils, admits that “we can generally recognise the zones from the appearance of the chalk alone, and that the fossils act as confirmatory evidence.” This, indeed, is the experience of those who have worked at zones, and it is only by utilising properly all the evidence that satisfactory results can be obtained. Lithological evidence, often invaluable, is essentially local; the paleontological evidence, so ably and exhaustively dealt with by Dr. Rowe, is clear and uniform throughout the areas with which he deals. The fossils, as he remarks, “never fail us,”—that is to say, when you find them, their testimony is safe after the experience he has gained. He has been fortunate in having such an excellent series of sections to work at, and these are well depicted in two folding plates, drawn by Mr. C. Davies Sherborn. Inland, of course, the observer has only a pit-section or road-cutting here and there to act as a guide to the zonal divisions, but no doubt with the aid of the clear descriptions given by Dr. Rowe, and of the ascertained thicknesses of the several zones, it might be possible and even desirable to trace inland their approximate boundaries, if any useful purpose were thereby gained. In any case, Dr. Rowe's work will be appreciated alike by field-geologists and paleontologists. Prof. J. W. Gregory describes a new *Echinoderm*, and Dr. F. L. Kitchin describes a new species of *Terebratulina* from the chalk.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. R. H. Yapp has been appointed assistant curator of the Herbarium under Prof. Marshall Ward.

Prof. Clifford Allbutt was on April 23 appointed physician to Addenbrooke's Hospital, in accordance with the recent agreement between the University and the governors.

Dr. Adami and Mr. de Soyres have been appointed delegates

to represent the University at the approaching Centennial of the University of New Brunswick.

The honorary degree of D.Sc. is to be conferred on Mr. Charles Hose, of Sarawak, to-day (April 26).

At the spring graduation ceremony of Edinburgh University, the honorary degree of LL.D. was conferred upon Miss E. O. Ormerod, Dr. C. D. F. Phillips, and (*in absentia*) Dr. A. Stuart, professor of physiology in the University of Sydney.

It is hoped (says the *Athenaeum*) that the Prince of Wales will preside at the next Presentation ceremony of London University, which will be held in the new home of the University at South Kensington on May 9.

THE governors of the Goldsmiths' Company Technical and Recreative Institute, New Cross, again report a decline in the number of students, owing to the establishment of free evening continuation classes close to the Institute by the London School Board. It will be remembered that the extension of the work of the School Board to technical education has been called into question, and that the official auditor has disallowed items in the Board's accounts referring to such expenditure. The School Board has appealed against his decision, and the whole matter will shortly be argued in the Queen's Bench Division. The engineering department of the Goldsmiths' Institute shows an increase of members, in spite of the competition of free continuation classes. It is satisfactory to notice that the governors are taking steps to encourage students to undertake systematic courses of study, extending over three or more years, and propose to periodically test the efficiency of such courses by appointing independent examiners in grouped subjects, and to award special certificates for such examinations. Mr. J. Carrington having given 100 guineas towards the encouragement of systematic study, a portion of that sum will, during the current year, be devoted to prizes in connection with these special courses. The governors report that the quality of the work done in the advanced classes in chemistry is excellent, and some useful research work is being carried on by the students.

THE annual income of the Technical Education Committee of the Derbyshire County Council is at present about 11,000*l.*, exclusive of Science and Art Department's grants. This income is used to supplement local effort, and not to supersede it. Promising students of elementary schools in the county are assisted to proceed to secondary schools, and really able students of secondary schools are enabled to proceed to University or Technical Colleges, or Universities. In addition to awarding these scholarships the Council assists the development of the work of secondary schools, by means of building and equipment grants, supply of apparatus, &c. Agricultural experiments are carried on in connection with the Agricultural Department of the Nottingham University College, and the Midland Dairy Institute, Kingston, Notts. All the work of these institutions is placed under the inspection of the Board of Agriculture, which aids the work by a grant of 700*l.* a year. An experiment commenced in 1897 at Egginton for the purpose of demonstrating the influence on the quantity and quality of the herbage of permanent grass land by the use of different kinds of natural and artificial fertilisers has been continued. Each year the grass upon the different plots is cut and weighed, and the proportions of the various grasses and plants constituting the herbage is estimated. A member of the University College staff experienced in such work superintends the laying out of the plots, the sowing of the manures, and the cutting and weighing of the grass. The area under experiment is two and three-quarter acres, and the size of the plots one-eighth of an acre. The results of the experiment have been published for use by the agriculturists of the counties which promoted it.

THE report of the Advisory Committee appointed to inquire into the best manner of providing for scientific and commercial training respectively in connection with the new University of Birmingham has just been issued. It will be remembered that Mr. Andrew Carnegie and an anonymous donor each promised a gift of 50,000*l.* towards the establishment of these two departments. The committee have made inquiries as to facilities for the teaching of science in its application to industries, and they report that, in their opinion, no such teaching, complete as they contemplate it, and as it must be if it is to be

successful, exists in any college in Great Britain. In making their recommendations, the committee have had in view the object of the teaching of science in its application to industry, coupled with such technical instruction in handicrafts as will enable the students to complete their course in the University itself. It is proposed that the facilities already provided in Mason University College should be supplemented by chairs of mining, metallurgy, engineering, and applied chemistry. The scheme submitted contemplates the introduction of a complete equipment for the treatment of metals by heat and a small plant for treatment by electricity, as well as the necessary outfit for testing metals. Shops would be provided for manual training, and it is recommended that the machines used should be of the best and most modern type of English, American, and foreign manufacture. The committee further recommend the acquisition of 25 acres of land in the outskirts of Birmingham on which to build the University, their estimate of the total cost being 155,000*l.*

SCIENTIFIC SERIALS.

American Journal of Science, April.—Skull, pelvis, and probable relationship of the huge turtles of the genus *Archelon* from the Fort Pierre Cretaceous of South Dakota, by G. R. Wieland. The marine turtles of the Fort Pierre Cretaceous of South Dakota not only represent the most gigantic species known, but also are of much importance as including undoubted descendants of *Protostega* from the underlying Niobrara Cretaceous, in common with which they may be regarded as ancient relatives of *Dermochelys*.—Application of the radio-micrometer to the measurement of short electric waves, by G. W. Pierce. A long loop of fine copper wire is suspended by a quartz fibre in a strong magnetic field. The lower ends are twisted together for some distance down, and carry at the bottom a mica vane on which is mounted a small resonator consisting of two vertical copper cylinders, joined by a constantan and a manganin wire which cross in the centre between the cylinders, and are attached to the ends of the copper wire. The impact of electric waves produces surges between the two cylinders, which heat the junction and produce a thermo-electric current in the copper loop. The latter turns in the magnetic field, and thus indicates the waves. The author confirms Righi's observations of the different transparency of wood along and across the grain.—A large slab of *Uintacrinus* from Kansas, by C. E. Beecher. This paper contains photographs of a slab of limestone preserving on its surface a number of fine specimens of *Uintacrinus socialis*, Grinnell. It has 27 square feet of surface, and contains 220 crinoids.—Granodiorite and other intermediate rocks, by W. Lindgren. Granodiorite, a member of the great family of rocks with predominating soda-lime feldspars, is distinguished by a granular texture, greyish colour, and a mineral composition of quartz, oligoclase or andesine, orthoclase or microcline, hornblende or biotite. The family represents an important and widespread type of rocks, especially common along the Pacific slopes of the Cordilleran ranges.—Two new American meteorites, by H. L. Preston. Describes the Luis Lopez siderite, characterised by the length of its bands of kamacite, and the Central Missouri meteorite, which is distinguished by the absence of etching figures, its beautiful pitting and prominent ridges of a lustrous dark steel-grey colour resembling graphite, and containing small quantities of carbon.

Annalen der Physik, No. 3.—Wave current generators, by C. Heinke. The author discusses variable currents from two different aspects. Some are generated as such, whereas others are generated by continuous currents broken up into variable currents by mechanical, liquid, or gaseous gaps in the circuit. The latter require a certain "saturation current" which is independent of the E.M.F.—Absorption of light in electrically glowing gases, by M. Cantor. Kirchhoff's law does not hold for electrically glowing gases, though it may hold for flames. The author sent a strong beam of light through a vacuum tube from end to end and back, and compared its intensity with a beam passing through the open air. The beam of light suffered no absorption by the glowing gas. This result could only be made to agree with Kirchhoff's law of radiation by supposing the gas to possess an extremely high temperature. This, as we know, it does not possess. Hence we have a case of emission

without absorption, which indicates that the light-producing mechanism is quite different from what it is in flames.—Analysis of oscillating jar discharges by means of the Braun tube, by F. Richarz and W. Ziegler. The authors note a curious appearance produced in a Braun cathode-ray tube when the fluorescent screen is moved in a direction at right angles to the oscillation of the beam influenced by the discharge. It is a kind of herring-bone structure, in which the slanting ribs are produced by the apparent coalescence of the points of reversal, where the track is brightest and the motion slowest.—A mixture of three powders for producing electric dust figures, by K. Bürker. A mixture far superior to the ordinary minium-sulphur combination may be obtained by mixing five volumes of flowers of sulphur with one volume of powdered carmine and three volumes of lycopodium seed. The colours are reversed with respect to the ordinary mixture.—Effect of ultra-violet light upon gaseous bodies, by P. Lenard. The author proves that not only cathode and Becquerel rays are able to make air electrically conducting, produce nuclei of condensation in it, and convert part of it into ozone, but the same effects are produced, though only to a slight extent, by the extreme ultra-violet rays. The source of light used was the electric spark, but the arc light, and even sunlight, contain some rays effective in this respect.—Quincke's rotations in the electric field, by L. Graetz. Instead of suspending spheres of the dielectrics by threads, the author mounts them in the electrolyte on points, so that they have freedom of rotation. The speed of rotation, when it becomes constant, gives a measure of the conductivity of the dielectric. This mode of measurement may be applied to measuring the conductivity of air ionised by Röntgen rays.—Electrolytic interruptor for feeble currents, by A. von Rzewuski. If the pressure of the acid upon the anode is increased, the current is interrupted at feebler E.M.F.'s. This is done by either making a reservoir of the acid some distance above the anode and connecting it by a tube.

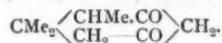
In *Symons's Monthly Meteorological Magazine* for April, Mr. A. B. MacDowall draws attention to a curious fact about London summers. Since 1841, the mean temperature of the summer months (June–August) at Greenwich has fluctuated between the extremes $57^{\circ}\cdot 4$ and $65^{\circ}\cdot 1$. If we select all the summers reaching or exceeding 63° , and all those reaching or falling below 60° , it will be observed that the hottest summers are nearly all in years ending with the figures 5 to 9, and that the coolest summers are mostly in years ending with 0 to 4. It would appear, therefore, that the earlier summers in a decade tend to be cooler, and the later summers hotter. The data previous to 1841 are not so trustworthy, but if we take Dr. Buchan's figures as the most dependable, it might be shown that as far back as 1810, at least, the same contrast is indicated. The author of the paper would be glad of any explanation of the cause of this feature in our summer weather.

SOCIETIES AND ACADEMIES.

LONDON.

Chemical Society, March 29.—Annual General Meeting.—Prof. Thorpe, President, in the chair.—After the delivery of the presidential address, a ballot was held for the election of officers and council for the ensuing year.—At an extra meeting held in the evening, Sir H. E. Roscoe, Vice-President, delivered the Bunsen Memorial Lecture.—April 5.—Prof. J. M. Thomson, Vice-President, in the chair.—The following papers were read:—The liquefaction of a gas by "self-cooling" (a lecture experiment), by G. S. Newth. The author exhibits the liquefaction of nitrous oxide by rapidly passing the gas from the slightly-warmed storage cylinder through a fine copper tube spiral inserted in a vacuum-jacketed test-tube.—Note on partially miscible aqueous inorganic solutions, by G. S. Newth.—The decomposition of chlorates. Part ii. Lead chlorate, by W. H. Sodeau. The slow decomposition of lead chlorate by heat consists of the two independent reactions: (1) $\text{Pb}(\text{ClO}_3)_2 = \text{PbCl}_2 + 3\text{O}_2$, and (2) $\text{Pb}(\text{ClO}_3)_2 = \text{PbO}_2 + \text{Cl}_2 + 2\text{O}_2$. The reaction $\text{PbO}_2 + \text{Cl}_2 = \text{PbCl}_2 + \text{O}_2$ simultaneously proceeds to a greater or less extent.—The bromination of benzeneazophenol, by J. T. Hewitt and W. G. Aston.—A new glucoside from willow-bark,

by H. A. D. Jowett. The author has isolated, from the bark of a species of *Salix*, the glucoside of methoxybenzaldehyde and gives to it the name salinigrin.—Alkylation by means of dry silver oxide and alkyl iodides, by G. D. Lander. Dry silver oxide and ethyl iodide react with acetanilide yielding ethyl *i*-acetanilide, $\text{C}_6\text{H}_5\text{N}:\text{C}(\text{OEt})\text{Me}$.—The interaction of mesityl oxide and ethyl sodiomethylmalonate, by A. W. Crossley. By the condensation of mesityl oxide with ethyl sodiomethylmalonate, ethyl trimethyldihydroresorcyate, $\text{C}_{12}\text{H}_{16}\text{O}_4$, is obtained; on hydrolysis it yields trimethyldihydroresorcinol,



—The products of the action of fused potash on dihydroxystearic acid, by H. R. Le Sueur.

Entomological Society, April 4.—Mr. G. H. Verrall, President, in the chair.—Mr. M. Jacoby exhibited specimens of the genus *Sagra* from Eastern Asia.—Mr. M. Burr exhibited three species of *Pseudophyllidae*, two new species of *Capnoptera* (females), and *Capnoptera quadrimaculata*, Westw. (female), collected in the Siamese Malay States by Mr. N. Annandale. The specimens illustrated the peculiar methods of protection adopted by the insect when alarmed.—Mr. H. J. Elwes communicated a paper on "Bulgarian Lepidoptera," and made some remarks on the more notable species which he had taken in the Balkan Peninsula during the months of June and July 1899. The number of species of *Rhopalocera* captured was 120, which, with a further 20 recorded by Haberhauer and Lederer, brings up the total to 140. The mountains visited were an extension of the Rhodope range where the climate was particularly rainy, a great number of ferns flourishing everywhere, in contrast to the drier Balkans, where the number of species of *Rhopalocera* is not less than 200. Some interesting forms but no new species were encountered. A variety of *Colias myrmidone* occurred much larger and brighter than the Austrian, and more nearly agreeing with the Ural form. The form of *Coenonympha dorus* met with showed an affinity with the Asiatic and not the European form. The form of *Argynnis pales* was intermediate between that found in Greece and the central European Alps, while a form of *Erebia*, var. *gorgone*, was taken similar to that in the Pyrenees—a curious instance of interrupted distribution.

Linnean Society, April 5.—Mr. C. B. Clarke, F.R.S., Vice-President, in the chair.—Mr. W. B. Hemsley, F.R.S., exhibited and made remarks on a selection of plants collected by Dr. A. Henry and Mr. W. Hancock in the neighbourhood of Mengtze and Szemao in Western China.—Dr. D. H. Scott, F.R.S., read a paper "on *Sphenophyllum* and its allies, an extinct division of the vascular cryptogams." The author explained that his purpose was not to communicate any new observations, but to give a summary of our present knowledge of the group and to discuss its affinities. He pointed out that the study of the Palaeozoic Flora not only greatly widens our conception of the three existing classes of Pteridophyta, but adds a fourth—that of the *Sphenophyllales*—to their number. The various views which have been held as to affinities of the *Sphenophyllales* were discussed in the light of the results recently attained. The supposed relation to *Hydropteride*, though supported by some ingenious arguments, was rejected as baseless, and as inconsistent with the manifest Filicinean affinities of that family. The author came to the conclusion that the *Sphenophyllales* were most naturally regarded as the derivatives of a synthetic group, combining the characters of Lycopods and Equisetales, and indicating the common origin of these two classes.

PARIS.

Academy of Sciences, April 17.—M. Maurice Lévy in the chair.—On the heat of combustion of some very volatile liquids, by MM. Berthelot and Delépine. The method for burning volatile liquids in the calorimetric bomb previously described by the authors involves the use of collodion films, and as collodion is not infrequently dissolved by the vapours of the liquid under examination, a new method has now been devised. The liquid is sealed up in a thin glass bulb, which it completely fills, and this bulb is burst in the bomb by a small piece of camphor, the weight and heat of combustion of which are exactly known. Determinations are given for aldehyde, methylal, methyl formate, ethyl formate, propaldehyde and isopropaldehyde.

hyde.—A rotating contact breaker, and some arrangements for producing powerful high frequency currents, by M. d'Arsonval. A description of the apparatus used in the decoration of the front of the electricity section at the Paris Exhibition. The condenser was of a special type, micanite plate immersed in petroleum being used; glass, ebonite, celluloid and paraffined paper were all found to be rapidly destroyed by the currents in use. A new device for breaking the circuit by blowing out an arc is also described.—On the *Stigmara*, by M. Grand'Eury. The observations of the author are opposed to the view that the *Stigmara* are the roots of *Sigillaria*, a study of over one hundred specimens showing distinct differences between the two kinds of roots. The true *Stigmara*, although frequently found together with the roots of *Sigillaria*, appear to have lived generally in much deeper waters.—Influence of periodic perturbations of semi-major axis upon the value of the mean motion deduced from the observations of a planet, and on the corresponding correction of the value originally adopted for the semi-major axis, by M. A. Gaillot.—On a simplified formula for calculating astronomical refractions, by M. L. Cruls.—On series of rational fractions, by M. Émile Borel.—On the characteristics of partial differential equations and the principle of Huygens, by M. J. Coulon.—Vortex motions with cellular structure. Optical study of the free surface, by M. Henri Bénard.—The increases of resistance in radio-conductors, by M. Édouard Branly. The usual effect observed in receivers for the Hertzian waves is a decrease of resistance. In certain cases, however, the opposite is the case, and the experimental results for a tube containing lead peroxide are given.—Induction and electrostatic oscillations, by M. P. de Heen.—Remarks on a recent note of M. G. le Bon, by M. P. Curie. The property of losing its luminosity possessed by a radiferous barium chloride, recently made the subject of a communication by M. le Bon, has been previously published by several authors.—A new microchemical reaction of palladium, by MM. M. E. Pozzi-Escot and H. C. Conquet. Potassium nitrite and excess of a caustic alkali give characteristic crystals with a solution of a palladium salt.—Experimental researches on the physiological phenomena accompanying chlorosis in the vine, by M. Georges Curtel. Chlorosis is accompanied in the diseased leaf with a marked decrease in the respiratory activity and diminution of the ratio $\text{CO}_2:\text{O}_2$, by a diminution or cessation of assimilation, and by a great decrease in the transpiratory function.—On a *Selaginella* from the coal-measures of Blanz, by M. R. Zeiller.—Sub-divisions of the Senonian in Portugal, by M. Paul Choffat.—On the production of calcium carbide, by M. L. K. Böhm.

DIARY OF SOCIETIES.

THURSDAY, APRIL 26.

ROYAL INSTITUTION, at 3.—A Century of Chemistry in the Royal Institution: Prof. J. Dewar, F.R.S.
INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Electric Transmission of Power: Prof. George Forbes, F.R.S.
INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Road Locomotion: Prof. Hele-Shaw, F.R.S.

FRIDAY, APRIL 27.

ROYAL INSTITUTION, at 9.—Nineteenth Century Clouds over the Dynamical Theory of Heat and Light: Lord Kelvin, G.C.V.O., F.R.S.
PHYSICAL SOCIETY (Solar Physics Observatory, Exhibition Road, South Kensington), at 8.—A short account of the Physical Problems now being investigated at the Solar Physics Observatory, and their Astronomical Applications: Sir Norman Lockyer, K.C.B., F.R.S.—Weather permitting, the 36-inch, 10-inch, and 9-inch telescopes will be used for the observation and photography of celestial objects and their spectra. The Appert-Spottiswoode coil and 21-ft. Rowland grating will also be in operation.

SATURDAY, APRIL 28.

ROYAL INSTITUTION, at 3.—Egypt in the Middle Ages: Prof. Stanley Lane-Poole.

MONDAY, APRIL 30.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Through Africa from the Cape to Cairo: Ewart S. Grogan.
INSTITUTE OF ACTUARIES, at 5.30.—Census-Taking: Dr. Reginald Dudley.

TUESDAY, MAY 1.

ROYAL INSTITUTION, at 3.—Studies in British Geography: Dr. H. R. Mill.

WEDNESDAY, MAY 2.

ENTOMOLOGICAL SOCIETY, at 8.
SOCIETY OF PUBLIC ANALYSTS, at 8.

THURSDAY, MAY 3.

ROYAL INSTITUTION, at 3.—A Century of Chemistry at the Royal Institution: Prof. J. Dewar, F.R.S.
LINNEAN SOCIETY, at 8.—Note on the Movements in Fishes: Prof. R. J. Anderson.—On New Species of *Halimeda*, from Funafuti: Miss E. S. Barton.—On West Indian Fungi: Miss A. L. Smith.
CHEMICAL SOCIETY, at 8.—Brazilin, Part IV.: A. W. Gilbody, W. H. Perkin, jun., and J. Yates.—Hæmatoxylin, Part V.: W. H. Perkin, jun., and J. Yates.—The Substituted Nitrogen Chlorides and Bromides derived from α - and β -acet-toluidine and their Relation to the Substitution of Halogens in Toluides and Toluidines: F. D. Chattaway and K. R. P. Orton.
RÖNTGEN SOCIETY, at 8.—Demonstration and Exhibition of New Methods and Results.
INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—If the discussion on Prof. Forbes's Paper, read on April 26, is concluded, the following Paper will be read:—The Calculations of Distributing Systems of Electric Traction under British Conditions: H. M. Sayers.

FRIDAY, MAY 4.

ROYAL INSTITUTION, at 9.—Pottery and Plumbism: Prof. T. E. Thorpe, F.R.S.
COLD STORAGE AND ICE ASSOCIATION (Examination Hall, Victoria Embankment), at 11.30.—Recent Researches in Refrigeration: G. Halliday.—Insulation and Insulators: W. D. A. Bost.—At 3.—Electric Lighting of Cold Stores: W. B. Esson.—The Design and Construction of Buildings for Ice Factories and Cold Storage: P. Gaskell.

SATURDAY, MAY 5.

ROYAL INSTITUTION, at 3.—Egypt in the Middle Ages: Prof. Stanley Lane-Poole.

CONTENTS.

PAGE

The Birds of Celebes	605
Pumping in Mines. By Prof. W. Galloway	606
The Palæontology of the Invertebrata	608
Inadequacy of the Cell-Theory. By J. A. T.	609
Our Book Shelf:—	
Renard and Stöber: "Notions de Minéralogie."—	
H. A. M.	610
"Muret-Sander's Encyclopædic English-German and German-English Dictionary"	610
Hertwig: "Die Elemente der Entwicklungslehre des Menschen und der Wirbelthiere."—E. A. M.	610
Letters to the Editor:—	
Recent Exploration in the Upper Air and its Bearing on the Theory of Cyclones.—H. H. Clayton	611
Rock-structures in the Isle of Man and in South Tyrol.—G. W. Lamplugh	612
Electric Light Wires and Dust.—A. A. C. Swinton	612
On the Size at which Heat Movements are manifested in Matter. By Prof. Geo. Fras. FitzGerald, F.R.S.	612
Report of the Malaria Expedition to Sierra Leone	614
Joseph Bertrand. (With Portrait.) By Prof. G. H. Bryan, F.R.S.	614
Notes	616
Our Astronomical Column:—	
Astronomical Occurrences in May	621
Photographs of the Aurora Spectrum	621
New Variable Star in Taurus	621
New Variable in Cassiopeia	621
Formula for Atmospheric Refraction	621
Determination of Axis and Compression of Neptune	621
The Relations between Electricity and Engineering. By Sir William Henry Preece, K.C.B., F.R.S.	622
The Significance of the Increased Size of the Cerebrum in Recent as compared with Extinct Mammalia. By Prof. E. Ray Lankester, F.R.S.	624
Zones in the Chalk	625
University and Educational Intelligence	625
Scientific Serials	626
Societies and Academies	627
Diary of Societies	628



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 1566, VOL. 61]

THURSDAY, NOVEMBER 2, 1899.

[PRICE SIXPENCE.

Registered as a Newspaper at the General Post Office.]

[All Rights are Reserved.

LIST OF NEW LANTERN SLIDES

WIRELESS TELEGRAPHY.

PLAIN SLIDES, 1s. EACH.

- | | |
|---|--|
| <ol style="list-style-type: none"> 1 Portrait of Professor Hertz, with Autograph. 2 Standard Hertz Resonator. 3 Prof. Oliver J. Lodge's Portrait. 4 Syntonic Leyden Jar Experiment 5 Spiral Wire Coherer. 6 Diagram of Lodge's Experiments with Receiver enclosed in metal 7 External View of Lodge's proposed Syntonic Signalling Stations. 8 Lodge's Single-point Coherer and diagrams of Coherer Circuits. 9 Lodge's & Muirhead's Improvements in Syntonic Telegraphy, showing all connections for a complete station. 10 Portrait of Sir W. H. Preece. 11 Diagram of Apparatus for Magnetic Induction, showing principle of Preece's system as adopted by the Post Office. 12 Lodge's Magnifying Telephone Devices, showing details of magnet and microphonic relay. 13 Complete arrangement of Lodge's Magnifying Telephones in series. | <ol style="list-style-type: none"> 14 Signor Marconi's Portrait. 15 Marconi's Short Distance Apparatus. 16 Marconi's Receiver and Transmitter. 17 Receiving Apparatus with Cover removed. 18 Wireless Telegraph Station at the S. Foreland Lighthouse. 19 The Marconi Transmitter in the Lighthouse, connected for Telegraphing to Wimereux. 20 The Receiving Apparatus at the Lighthouse connected up. 21 The Mast carrying the Vertical Wire at the S. Foreland Lighthouse. 22 Receiving a Message at the S. Foreland Station. 23 The Mast at the Wimereux Station. 24 Receiving a Message from Dover at Wimereux. 25 Facsimile and Transcription of Dot and Dash Message sent by the Queen from Dover to Wimereux to the Mayor of Boulogne. |
|---|--|

Full detailed List of Lanterns and Slides on application, Six Stamps.
NEWTON & CO., 3 FLEET STREET, E.C.

BECK'S

NEW

MICROSCOPE

THE

"BRITISH STUDENTS."

Microscope Stand No. 55, as figured, with Iris Diaphragm, One Eye-piece; Double Nose-piece, Two Object-glasses, 2/3" and 1/6", adjusted to be in about focus, and the whole packed in polished Mahogany Case.

£6 : 8 : 6

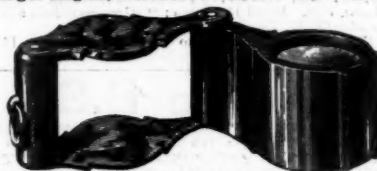


No. 55.

R. & J. BECK, Ltd.,
68 CORNHILL, LONDON. E.C.

BROWNING'S PLATYSCOPIC LENS.

With Larger Angles, Increased Field, and Improved Definition



Engraved Real Size.

AN ACHROMATIC COMBINATION,

COMBINING THE DEFINITION OF A MICROSCOPE WITH THE PORTABILITY OF A POCKET LENS.

"If you carry a small Platyscopic Pocket Lens (which every observer of Nature ought to do)."—GRANT ALLEN in *Knowledge*.
The Platyscopic Lens is invaluable to botanists, mineralogists, or entomologists, as it focuses about three times as far from the object as the Coddington Lenses. This allows opaque objects to be examined easily.
The Platyscopic Lens is made of four degrees of power, magnifying respectively 10, 15, 20, and 30 diams.; the lowest power, having the largest field, is the best adapted for general use.
The Lenses are set in Ebonite Cells, and mounted in Tortoiseshell Frames.
*Price of the Platyscopic Lens, mounted in Tortoiseshell, magnifying either 10, 15, 20, or 30 diameters, each power, 18s.
In nickelised German Silver, each power, 17s. 6d.*
Illustrated Description sent free.

JOHN BROWNING, 63 STRAND, LONDON, W.C.

SPECTACLES

FOR

ELECTRIC LIGHT, INCANDESCENT GAS,

And other Powerful Illuminants.



NEGRETTI & ZAMBRA'S

THERMOSCOPIC LENSES

Protect the Eyes from Glare, and
RENDER THE LIGHT SOFT AND COOL.
*Illustrated Price Lists of Optical and Meteorological Instruments,
Free by Post to all parts of the World.*

NEGRETTI AND ZAMBRA,
SCIENTIFIC INSTRUMENT MAKERS TO THE QUEEN,
38 HOLBORN VIADUCT, E.C.
BRANCHES: 45 CORNHILL 122 REGENT STREET.

BALLIOL COLLEGE, CHRIST CHURCH, AND TRINITY COLLEGE, OXFORD.

NATURAL SCIENCE SCHOLARSHIPS AND EXHIBITIONS.

A Combined Examination for Natural Science Scholarships and Exhibitions will be held by the above Colleges, beginning on TUESDAY, NOVEMBER 21, 1899.

Three Scholarships and Two Exhibitions will be offered, the Scholarships being worth £80 a year.

The Subjects for Examination will be Physics, Chemistry, and Biology; but Candidates will not be expected to offer themselves in more than two of these.

Particulars may be obtained by application to
Christ Church, Oxford. A. VERNON HARCOURT.

LONDON COUNTY COUNCIL. TECHNICAL EDUCATION BOARD.

LECTURES ON SEWAGE AND ITS PURIFICATION.

A Course of Twelve Lectures, by Dr. S. RIDEAL, F.I.C., will be delivered at University College, Gower-street, W.C., on Mondays at 5.30, commencing November 6.

For particulars apply to the SECRETARY of the College or to the undersigned.

WM. GARNETT, Secretary of the Board.
116 St. Martin's Lane, W.C.

INSTRUCTION IN PURE CULTIVATION OF YEAST,

According to HANSEN'S Methods.

Courses for Beginners, as well as for Advanced Students, in Physiology and Technology of Fermentations—Biological Analysis of Yeast.

Manuals:—E. Chr. Hansen: "Practical Studies in Fermentation." London (Spon), 1896. Alfred Jørgensen: "Micro-organisms and Fermentation." London (F. W. Lyon), 1893.

Further Particulars on Application to the Director, ALFRED JØRGENSEN, The Laboratory, Copenhagen. V.

B.A. AND B.Sc. MATRICULATION, INTERMEDIATE, FINAL.

PREPARATION BY CORRESPONDENCE AND ORAL TUITION on a THOROUGHLY INDIVIDUAL SYSTEM. Fees based on success.

The STAFF includes Graduates of Oxford, Cambridge, London, and Royal Universities, Science Medallists, Prizemen, Scholars, &c.

SINGLE SUBJECTS TAKEN: Latin, Greek, French, German, Mathematics, Science, Logic, Psychology, Political Economy, &c.

For Terms, &c., address Mr. J. CHARLESTON B.A. (Lond. and Oxon.), The Burlington Classes, 27 Chancery Lane, London, W.C.

Telegrams—"Tunzelmann, London."

THE GENERAL ENGINEERING COMPANY, LTD.,

2 and 4 PENYWERN ROAD, LONDON, S.W.

G. W. DE TUNZELMANN, Managing Director.

Mechanical, Electrical and Chemical Patents experimentally developed and Models constructed for Inventors. Special Machinery and Apparatus designed and carried out to Specification. Every description of Accurate work. Repetition work with all parts interchangeable.

CITY OF LONDON SCHOOL.

WANTED A PHYSICAL SCIENCE MASTER, to attend about thirty hours a week, to give instruction in Physical Science and in Mathematics.

The Salary will be £300 a year, increasing to £450 a year. Candidates for the appointment are requested to forward their applications, accompanied with a copy of testimonials as to qualification and character, not later than Tuesday, the 21st of November next, to A. J. AUSTIN, Secretary, at the School, Victoria Embankment, E.C. Selected candidates will be duly communicated with.

Forms of application can be obtained of the SECRETARY. A gentleman not over 35 years of age will be required.

APPLICATIONS (addressed to the

MINISTER OF EDUCATION, Toronto, Ontario, Canada) will be received up to January 1, 1900, for the position of PROFESSOR of CHEMISTRY in the University of Toronto. The Salary attached to the position is 2500 dols., rising by annual increments to 3200 dols.

For further particulars address Dr. W. H. PIKE, care of the High Commissioner for Canada, London, E.C., or the PRESIDENT, University of Toronto, Toronto.

October, 1899.

ROYAL COLLEGE OF SCIENCE, DUBLIN.

DEMONSTRATOR in CHEMISTRY and ASSAYING required in Department under Professor HARTLEY, F.R.S. Salary, £60.

Applications, with copies of testimonials, to be addressed to the SECRETARY.

November 23, 1899.

BIRKBECK INSTITUTION,

Breams Buildings, Chancery Lane, E.C.

Science Classes with Practical Work.

DAY AND EVENING CLASSES for University of London B.Sc.; Prelim. Scientific, Inter. M.B. Examinations and for Conjoint Board, Dental and Pharmaceutical Examinations.

EVENING CLASSES in all stages for Science and Art Department Examinations.

HIGHLY-EQUIPPED LABORATORIES.

Chemistry, Physics, Biology (Zoology and Botany), Metallurgy, Geology and Mineralogy, Microscopy.

Prospectus free, Calendar 6d. (Post 8d.) on application to Secretary.

HEATHCOTE SCIENCE LABORATORIES.

These Laboratories are open for RESEARCH work, at any hours or times most convenient for worker, in Chemistry, General Physics and Bacteriology. Commercial processes can be worked out in Chemistry and Electricity, and powerful Currents, Constant or Alternating, can be used.

Eight feet of Bench fitted with Sink and Cupboard, Electricity, Gas, Water and Exhaust, £3 3s. for one month.

Private room, with same fittings, £5 4s. 6d. for one month.

The above includes use of all ordinary Glass and other Apparatus and use of Accurate Balances, and other Standard General Instruments, also Furnaces, &c.

For further particulars apply, THE DIRECTOR, Heathcote Science Laboratories, 9 Heathcote Street, Gray's Inn Road, W.C.

TECHNICAL COLLEGE, HUDDERSFIELD.

PRINCIPAL—S. G. RAWSON, D.Sc.

Applications are invited, not later than November 13, for the newly-founded Lectureship in Latin and Greek. Salary £150 per annum. Further particulars may be obtained upon application.

THOS. THORP,
Secretary.

CHEMIST AND PHYSICIST (aged 29),

trained at the Technische Hochschule in Hanover, and late Private Assistant in the Physical Department of the same Institution, seeks Situation as ASSISTANT. Advertiser is in possession of lathe, tools, &c., and can undertake entire construction of instruments, including repair of glass. First-class English and German references. ERNEST PORTER, c/o Office of this Paper.

ASSISTANT WANTED FOR PRIVATE

PHYSICAL LABORATORY in Glasgow. Mechanical and Theoretical Qualifications desirable. Facilities for Research.—Apply, stating experience and remuneration expected, to "X.Y.Z.," Byres Road, Glasgow.

INCANDESCENT GAS MANTLES.—

Required to complete a collection showing the progress of the Incandescent Gas Industry, duly authenticated specimens of Incandescent Mantles as used in England in the year 1892 (imported or otherwise). A liberal price will be paid for suitable authentic specimens duly guaranteed, or information leading to tracing them.—Address CURATOR, 117 Chancery Lane, W.C.

WANTED.—To Purchase some Second-

hand PHYSICAL INSTRUMENTS, or a Set. Also a Second-hand CHEMICAL BALANCE. Price must be moderate.—"A," care of NATURE Office, St. Martin's Street, W.C.

WANTED.—Second-hand Astronomical

REFRACTING TELESCOPE, 4½-inch to 6-inch aperture.—Offers to HERRMANN, 7 Achilles Road, West Hampstead.

Sale by Auction

TUESDAY NEXT.—THE GREAT CURIO SALE.

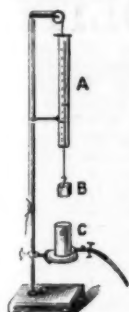
MR. J. C. STEVENS will Sell by Auction,

at his Great Rooms, 38 King Street, Covent Garden, as above, at 12.30 precisely, a Museum of Benin Relics and Bronzes collected by an Army Officer during the first campaign, including many remarkable and unique specimens; also Curiosities from New Guinea; Carved Ivories, Cabinets, Screens, &c., from Japan; Antiquities, &c., from the Collections of the late Sir H. Dryden; also an Egg of the *Cepornis Maximus*, measuring nearly a yard in circumference.

On view Day prior, to till 4, and Morning of Sale, and Catalogues had.

MOORE'S "HYDROSTATIC BALANCE

FOR ILLUSTRATING THE "PRINCIPLE OF ARCHIMEDES" AND SPECIFIC GRAVITY.



- A is a delicate spring balance accurately graduated to read Grams, and is capable of being lowered or raised by the string shown.
- B is one of the set of cubes of various metals supplied with the apparatus.
- C is a glass vessel with fixed mark etched in glass, up to which water, or other liquid, is placed. The vessel is provided with draw-off cock.

Sole Makers of this Apparatus—

BREWSTER, SMITH, & CO.,
6 CROSS STREET, FINSBURY, E.C.

Manufacturers and Importers of Chemical and Scientific Apparatus and Pure Chemicals.

WEIGHTS A Speciality, 500 Milligrams to 1 Milligram, 1s. 6d. per doz.

SEND FOR COMPLETE ILLUSTRATED CATALOGUE.

FREDK. JACKSON & Co.

(Late MOTTERSHED & CO.),

14 CROSS STREET, MANCHESTER.

Goods Entrance: 10 Half-Moon Street,

LABORATORY FURNISHERS,
Importers, Manufacturers, and Dealers in
**CHEMICAL AND PHYSICAL
APPARATUS**

Of every Description.

Fine Chemicals, Volumetric Solutions,
Plain and Stoppered Bottles,
AND EVERY LABORATORY REQUIREMENT.

Illustrated Catalogue of Apparatus, with Price List
of Chemicals, free on application.

Telegraphic Address—"APPARATUS, MANCHESTER."
Telephone Number—2038.

PATENTS.

JAMES G. LORRAIN, M.I.E.E., M.I.MECH.E., &c.,

CHARTERED PATENT AGENT,

Norfolk House, Norfolk Street, LONDON, W.C.

Speciality—PHYSICAL PATENTS,

OPPOSITIONS, AND AMENDMENTS.

Charges on Application.

Telephone No. 2511 GERRARD.

Telegrams: "LORRAIN, LONDON."

"Patentees' Handbook" Post free on application.

THE SCIENTIFIC ROLL AND MAGAZINE OF SYSTEMATIZED NOTES.

THIS WORK IS A VALUABLE

GUIDE, BIBLIOGRAPHY, AND INDEX TO SCIENCE.

This work, now in course of publication, embraces:

1. A *Bibliography* classified according to subjects arranged (1) according to the year of publication, and (2) alphabetically under each year according to the name of the author; each item has its distinctive number for reference purposes.
2. An *Index*, which, although arranged alphabetically, is classified in groups more than is usual in an index, the object being to render it possible, at some future time, to amalgamate the various subject indexes into one general classified index.
3. A *Systematized Collocation of Facts* grouped according to their relationship to each other. The aim of the whole is to enable any person engaged in scientific research to find the information he seeks with a minimum expenditure of trouble, time and cash.

As the work is the result of forty years' labour, its main features cannot be fully described in a short advertisement. All persons interested in the classification of scientific data, especially those commencing a research, are invited to send for a prospectus and fuller particulars to

A. RAMSAY,
4 Cowper Road, Acton, London, W.

Just Published. With 564 Illustrations. Large Crown 8vo.
10s. 6d.

A TEXT-BOOK OF PHYSICS.

By W. WATSON, B.Sc.,

Assistant Professor in Physics in the Royal College of Science, London;
Assistant Examiner in Physics, Science and Art Department.

For use in Technical Schools, Advanced Science and Art
Classes, Engineering Schools, Universities, &c.

London: LONGMANS, GREEN, & CO.

PHYSICAL AND MECHANICAL APPARATUS.

EVERETT & CO.,

Engineers and Electricians,

22 CHARTERHOUSE SQUARE, LONDON, E.C.
Scientific and Electrical Instrument Makers.

Apparatus for Laboratories, &c., designed and made to meet any
requirements.

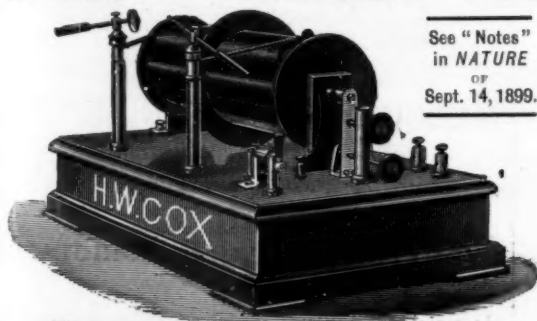
MACHINES FOR ANY SPECIAL PURPOSE BUILT TO ORDER.

MODELS DESIGNED AND MADE FOR INVENTORS.

Accuracy combined with Highest Skill at Reasonable Charges.

REPAIRS OF EVERY DESCRIPTION.

X-RAY & ÆTHERIC TELEGRAPHY APPARATUS



See "Notes"
in NATURE
OF
Sept. 14, 1899.

OF THE HIGHEST QUALITY AND FINISH ONLY.

As supplied by us to H.M. Government and the leading
Hospitals and X-Ray Workers throughout the World.

We are the actual Manufacturers, and Guarantee
every Coil against breaking down.

CALL OR WRITE FOR OUR NEW ILLUSTRATED LIST, WITH
TESTIMONIALS AND ILLUSTRATED INSTRUCTIONS UPON HOW
TO WORK. POST FREE TO READERS OF "NATURE."

HARRY W. COX, Ltd.,

10, 11, 28 CURSITOR STREET,
CHANCERY LANE, LONDON.

Radiographs taken for Scientific and Medical Men, and
Demonstrations given.

NOW READY. Crown 8vo, Cloth, price 1s. 6d. net.

NEWTON'S LAWS OF MOTION.

By PROF. P. G. TAIT, M.A., Sec.R.S.E.,
Author of "Light," "Properties of Matter," and "Dynamics."

NOW READY. PRICE 16s. net.

Cheap Issue in one handy volume, Demy 8vo, Cloth, 1232 pages.

A DICTIONARY OF BIRDS.

BY

ALFRED NEWTON, M.A., F.R.S.,

Professor of Zoology and Comparative Anatomy in the University of Cambridge.

ASSISTED BY

HANS GADOW, F.R.S.

WITH CONTRIBUTIONS FROM

RICHARD LYDEKKER, B.A., F.R.S.,

CHARLES S. ROY, M.A., F.R.S.,

AND

ROBERT W. SHUFELDT, M.D.

Containing 340 Illustrations and a Map.

"The most comprehensive review of the subject of ornithology extant, and in it will be found a concise summary on most of the important works of ornithology from the earliest times."—*Nature*.

NOW READY. Crown 8vo, Cloth, price 6s.

RESEARCHES IN THE HISTORY OF ECONOMICS.

By PROF. E. NYS, LL.D.

TRANSLATED BY

N. F. AND A. R. DRYHURST.

"The volume gives a most instructive account of the origins of economic theory."—*The Scotsman*.

"Prof. Nys brings to his task great erudition, and his previous studies of the origins of international law enable him to throw some novel side-lights on the mutual play of economic and legal forces."—*The Glasgow Herald*.

In Demy 8vo, Boards, price 3s. 6d. net.

A CLASSIFICATION OF VERTEBRATA,

RECENT AND EXTINCT.

With Diagnoses and Definitions, a Chapter on Geographical Distribution, and an Etymological Index.

By HANS GADOW, M.A., Ph.D., F.R.S.,

Strickland Curator and Lecturer on Zoology to the University, Cambridge.

"It is a book—it need hardly be said—for the student; it is simply a list of the principal sub-divisions of back-boned animals, with just as much definition as is needed. It may be regarded as an exceedingly concentrated extract of a full text-book of the vertebrates."—*The Daily Chronicle*.

Demy 8vo, Cloth, price 18s. net.

ZOOLOGY OF THE INVERTEBRATA.

A Text-Book for Students.

By A. E. SHIPLEY, M.A.,

Fellow and Assistant Tutor of Christ's College, and Demonstrator of Comparative Anatomy in the University of Cambridge.

Illustrated with 263 Figures.

"In classification, Mr. Shipley is convincing and ingenious. The book is well illustrated, well indexed, and conveniently arranged."—*Natural Science*.

A. & C. BLACK, SOHO SQUARE, LONDON, W.

THE BRIDGES-LEE PHOTO-THEODOLITE

The most perfect Instrument invented for Survey Work in Mountainous Districts, and for Military or Rapid Surveys.

The Photo-Theodolite automatically records on the photograph all, or nearly all, the data necessary for the reduction of the photographs, including the Magnetic bearings, — thus considerably reducing the time spent and the risk of error in the interpretation of the photographs.

The Instrument is fitted with an Aluminium Body, 6-in. Azimuthal Circle, reading with Vernier to one minute of arc, 4-in. Compass, divided to half degrees. Telescope with erect and inverting Eye-pieces, rapid Rectilinear Lens with Iris Diaphragm and Colour Screen, six double dark Slides in Mahogany Case, with Stand complete, **£45.**

Descriptive Pamphlets and Illustrated Description of the Instrument sent free on application.

AGENT FOR RICHARD FRÈRES' AUTOMATIC RECORDING INSTRUMENTS.

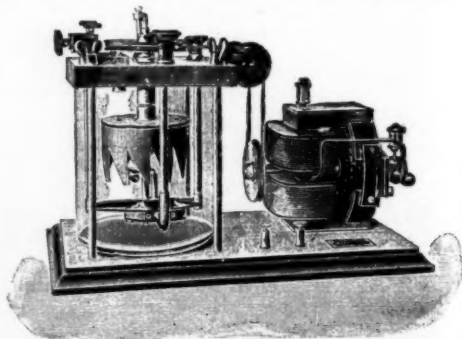
L. CASELLA,
147 Holborn Bars, London, E.C.
Telegraphic Address: "Es-utcheon, London." Telephone: Holborn 1054.

ISENTHAL, POTZLER & CO.,
85 MORTIMER STREET, LONDON, W.

Telegrams: "HYSTERESIS."

Telephone: 2099, GERRARD.

CENTRAL DEPOT for RADIOGRAPHERS.



MERCURY JET INTERRUPTER.

3000-50,000 Interruptions per Second.

Write for Lists, or better inspect our Installations.

HIGHEST REFERENCES.

EVERYTHING NOVEL & ORIGINAL.

Sole Agents for Scotland:

Messrs. JAMES WHITE, Cambridge Street, Glasgow.

DUDELL OSCILLOGRAPH

**An Invaluable Instrument for
Alternate Current Work.**

This Galvanometer has the shortest
periodic time of any Instrument
yet constructed, viz. 0.0001 Second,
is perfectly dead-beat and the self-
induction is practically nil.

Write for Descriptive Pamphlet.

SOLE MAKERS—

**SCIENTIFIC INSTRUMENT CO.
LIMITED,
CAMBRIDGE.**

MECHANICAL LABORATORY APPARATUS.

**G. CUSSONS,
THE TECHNICAL WORKS,
104 Great Clowes Street, Lower Broughton, Manchester.**

CUSSONS' Patent Atwood Machine, Sensitive but Rigid, Electric
Release, Special Weights, &c., and Timing arrangement.

EXPERIMENTAL FLUID FRICTION APPARATUS

Apparatus to determine the efficiency of Screws, Worms, Springs, Pulley
Tackle, Plain and Ball Bearings, Inertia of Heavy Wheel, Kinematics, &c.

[Sectional Gas and Steam Engines. Machine Details and
Building Construction.

**ADAM HILGER,
OPTICIAN,
204 STANHOPE ST., LONDON, N.W.
MAKER OF**

Astronomical Object-Glasses and
Mountings.
Glass Prisms of all Refractive
Indices from 1.5 to 1.96.
Quartz, Iceland Spar, Fluor Spar,
and Rock-Salt Prisms and Lenses.
Cell Prisms, Polarising Prisms
and Tourmalines.
Bright Pointer, Shutter, and Fluor-
escent Eye-pieces.
Photo-measuring Micrometers.
Abney's Colour Photometer and
Sector.

Pritchard's Wedge Photometer.
Secchi's Disc Prisms.
Spectroscopes for Laboratory,
Stellar, or Solar Work.
Direct Vision Pocket Spectroscopes.
Symmetrical and Double Slits, and
other requirements for Spectro-
photometry.
Micrometer Gauges, Spherometers
&c., &c.
Quartz Slits with Microscopic
Knife-edges, perfectly opaque to
the extreme edge.

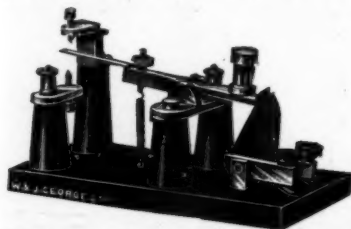
Telegraphic Address—"SPHERICITY, LONDON."

"NIVOC" SPECIALITIES.

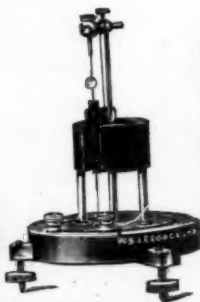
WORKS—BIRMINGHAM.

*Burn direct from the
Manufacturers.*

THESE INSTRUMENTS ARE SPECIALLY
SUITED OR WORKING TOGETHER.



KEMPE'S CHARGING & DISCHARGING KEY,
Improved Form with rubbing contacts, highly
insulated, £3 15s. Highest quality and finish.
(Late F. E. BECKER & CO)



"NIVOC" MOVING COIL GALVANOMETER
BALLISTIC, very sensitive. To work with $\frac{1}{2}$ Micro-
Farad Condenser, £2 10s.



STANDARD CONDENSER, $\frac{1}{2}$ Micro-
Farad, £2 12s. 6d.

STANDARD CLARK CELL, 25s. net.

W. & J. GEORGE, LTD., 33-37 HATTON WALL, LONDON.

CO-OPERATIVE WORLD TRAVEL

Organised by HENRY S. LUNN, M.D., F.R.G.S.,
W. HOLDSWORTH LUNN, & CONNOP F. S. PEROWNE.

A Cruise to the WESTERN MEDITERRANEAN.

TILBURY, LISBON, TANGIER, GIBRALTAR, ALGIERS, PALMA,
MARSEILLES.

A FOURTEEN DAYS' CRUISE FOR £11 11s. AND UPWARDS.

A Cruise to the EASTERN MEDITERRANEAN.

(Return ticket to MARSEILLES included.)

MARSEILLES, SYRACUSE, PIRÆUS (for Athens),
CONSTANTINOPLE, JAFFA (for Jerusalem), ALEXANDRIA,
MALTA, NAPLES, MARSEILLES.

A THIRTY-FIVE DAYS' CRUISE FOR £36 15s. AND UPWARDS
S.V. ARGONAUT. Tonnage, 3254; h.-p., 4000.

Full particulars from the Secretary, 5 Endsleigh Gardens,
Euston, London, N.W.

PHŒNIX FIRE OFFICE,

19 LOMBARD ST., E.C., and 57 CHARING CROSS, S.W.

ESTABLISHED 1782.

MODERATE RATES. ABSOLUTE SECURITY.

ELECTRIC LIGHTING RULES SUPPLIED.

LIBERAL LOSS SETTLEMENTS.

PROMPT PAYMENT OF CLAIMS.

FRANCIS B. MACDONALD, SECRETARY.

LOSSES PAID OVER £22,000,000.

ESTABLISHED 1851.

BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

INVESTED FUNDS

£10,000,000.

The BIRKBECK ALMANACK, with full particulars, post free.

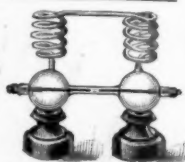
FRANCIS RAVENSCROFT, Manager.

GLASS BLOWING.

All kinds of Experimental Glass
Blowing carried out for Scientific
Men, Laboratories, &c.

INVENTORS' IDEAS WORKED OUT AS PER INSTRUCTIONS.

COSSOR,
67 Farringdon Road, E.C.



Hittorf's Tube showing the resistance of the dark space

THE MOST NUTRITIOUS.

E P P S'S

GRATEFUL—COMFORTING.

C O C O A

BREAKFAST—SUPPER.

WATKINS & DONCASTER,

NATURALISTS,
AND MANUFACTURERS OF

CABINETS AND APPARATUS

FOR ENTOMOLOGY, BIRDS' EGGS, AND ALL BRANCHES OF
NATURAL HISTORY.

SPECIAL SHOW-ROOM FOR CABINETS.

Call or send for detailed Catalogue (66 pp.), Post free on
application.

N.B.—For Excellence and Superiority of Cabinets and
Apparatus, references are permitted to distinguished
patrons, Museums, Colleges, &c.

A LARGE STOCK OF INSECTS AND BIRDS' EGGS.

Birds, Mammals, &c., Preserved and Mounted by First-class Workmen
with true natural surroundings. All Books and Publications on Natural
History supplied.

36 STRAND, LONDON. W.C.

(Five Doors from Charing Cross.)

MINERALS, ROCKS & FOSSILS.

COLLECTIONS FOR STUDENTS.

Carefully labelled and arranged in Boxes with Card Trays.

50 Minerals, 12/6; 100 do., 21/-; 200 do., 42/-.

Rocks and Fossils at similar prices.

300 Minerals in Cabinet, £4 4s.; 400 do., £5 12s. 6d.

Catalogues Post Free.

THOMAS D. RUSSELL.

78 NEWGATE STREET, LONDON, E.C.

MINERALS AND PRECIOUS STONES.

Mr. HENSON has now on hand a Fine Series of interesting Sapphires,
also Topazes, Gold, and Barytes in Large Crystals of various Colours.

Large and perfectly clear Rock Crystal Balls, precious Opal Cameos,
Fluor Spar, Agate, Jasper, and other Stones cut for ornamental purposes.

LESSONS GIVEN.

SAMUEL HENSON,

97 REGENT STREET, LONDON, W.

ESTABLISHED 1840.

ALBERT EDWARD JAMRACH

(Late CHARLES JAMRACH),

NATURALIST,

180 ST. GEORGE STREET EAST.

Implements of Savage Warfare, Idols, Sacred Masks, Peruvian Pottery
Netsukis China, Lacquers, Gongs, Shells, and other Curios.

HOLLOWAY'S OINTMENT CURES

Gout, Rheumatism, Lumbago, Sciatica, Cuts,
Bruises, Sprains, &c.

INVALUABLE FOR ALL SKIN DISEASES.

Holloway's Ointment and Pills may be obtained of
all Medicine Vendors.

HARVEY & PEAK

HAVE FOR DISPOSAL

A VERY LARGE AND RARE

PROJECTION POLARISCOPE.

Including Nicol Polariser of $3\frac{1}{2}$ inches aperture, Nicol Analyser of $3\frac{1}{4}$ inches aperture,
many large Sections of Quartz, Quartz Devices, Crystals, Double Image Prisms,
Selenites, &c., in Mahogany Cabinets.

56 CHARING CROSS ROAD, LONDON, W.C.

A NEW STEREOSCOPIC BINOCULAR FIELD GLASS

Of NEW FORM and CONSTRUCTION.



(English Patents, Nos. 5639 and 7943, 1894.)

Of handy size, with large field, brilliant definition, perfect achromatism, and very decided STEREOSCOPIC effect, and which, when once adjusted, are always ready for use.

Prices: £6 to £8.

For NAVAL MEN and DEERSTALKERS, &c. (we have made larger sizes for NIGHT and DAY USE, admitting more light, but of somewhat greater weight). Prices: Night, £10; Day, £11.

Illustrated Price List free.

CARL ZEISS,

89 MARGARET STREET, REGENT STREET, LONDON, W.

SECOND-HAND MICROSCOPES

By SWIFT, WATSON, CROUCH, BECK, ZEISS, LEITZ, &c.
Prices from £2 10s. to £45.

A Large Selection of Second-hand Powers and Fittings for all kinds of Microscopes.

Send for New List.

CLARKSON & CO., 28 Bartlett's Buildings, Holborn Circus, E.C.

TO SCIENCE LECTURERS. HUGHES' MOTO-PHOTOSCOPE FOR LIVING PICTURES. THE MOST PERFECT.

No SHUTTER, therefore no Flickering. Superb Mechanism.

The Moto-Photo Camera for taking the Pictures. Illustrated Lists, ad. See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN, &c. Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great success. New Oxyhydrogen Microscope. Science Lanterns for Class Demonstration. Magnificent Results. Docwra Triple, Prize Medal, Highest Award. Supplied to the Royal Polytechnic Institution, Dr. H. GRATTAN GUINNESS, Madame ADELINA PATTI, &c., &c. Patent Pamphengos Science Lanterns. The Universal Lantern 4-inch Condensers. 4-wick Lamp, Portrait Combination front Lenses, 18s. 6d., Marvellous value. Science Lecture Sets. Novelties. The Lantern Kaleidoscope. Cheapest Lantern Outfits in the World. Grandly Illustrated Catalogue, over 180 choice Engravings, 6d.; Postage, 3d. List of 300 Lecture Sets, Science Subjects, Views, &c., 6d.; Postage 3d. Pamphlets Free.—W. C. HUGHES, SPECIALIST, Brewster House, 82 Mortimer Road, Kingsland, N.

W. G. PYE & CO. Physical & Physiological Instrument Makers, 30 ST. ANDREW'S STREET, CAMBRIDGE.

STUDENTS'
BRIDGE
Aggregate
Guaranteed
Platinoid



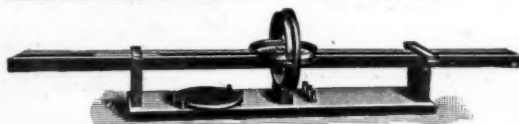
WHEATSTONE
BOX.
12,220 ohms
to 1 in 500.
Wire.

Price £9 10s., as illustrated. Smaller Boxes, from £3.

IMPROVED REFLECTING GALVANOMETER,
for use with above, any resistance to 2000 ohms, £3.
Galvanometer Shunts, Galvanometer Lamps and Scales,
Keys, Single Coils, Batteries, &c.

Reliable Apparatus at low prices for teaching Mechanics, Hydrostatics, Heat, Optics, Magnetism and Electricity, as supplied to many of the leading Technical Institutes and Organised Science Schools.

Physical and Physiological List—Sixpence, Post free.



Tangent Galvanometer and Magnetometer, £2 5s.

T. TAMBLYN-WATTS, Scientific Apparatus Maker.
Electrical and Mechanical Catalogues, 6d. each, Post free.
GOLDIELANDS, SETTLE, YORKS.

OPTICAL & SCIENTIFIC INSTRUMENTS.

Spectrometers, Spectroscopes, Goniometers, Cathetometers, Optical Benches, &c., &c. Instruments for special purposes constructed to Clients' own designs. Price List on application.

W. WILSON (formerly Foreman at Messrs. ELLIOTT BROS.),
1 Belmont Street, Chalk Farm Road, London, N.W.
CONTRACTOR TO H.M. GOVERNMENT.

BORD'S PIANOS

25 per cent. Discount for Cash, or 14/6 per month (second-hand, 10/6 per month) on the Three Years' System. Lists free of
C. STILES & CO., 40 & 42 Southampton Row, London, W.C
PIANOS EXCHANGED.

BECHSTEIN PIANOS

These magnificent Pianos for Hire on the Three Years' System at advantageous prices and terms. Lists and particulars free of
CHAS. STILES & CO., 40 & 42 Southampton Row, LONDON, W.C.

"OPTIMUS" CANTILEVER PHOTOGRAPHIC ENLARGER.

Incandescent Gas,
7s. 6d. extra.



This already popular model is finished in a very superior and practical style. The lamp gives a brilliant and even light. The optical system is throughout the best. The Lens will be found to give a very flat field and good marginal definition.

* SUITED FOR POCKET
CAMERA NEGATIVES.

Diam. of Condenser ...	4in.	5in.	6in.	8in.	10in.
Price, no Front Lens ...	62/-	70/-	80/-	110/-	200/-
Extra for Front Lens ...	27/-	27/-	37/-	63/-	63/-
Covering Plates ...	3 1/2 x 3 1/2	4 1/2 x 3 1/2	6 1/2 x 4 1/2	8 1/2 x 5 1/2 in.	

Catalogue POST FREE.

"OPTIMUS" MAGIC LANTERNS FOR DRAWING ROOM AND LECTURE HALL

Each Lantern is efficient for Exhibitions. The Lens gives crisp definition, being a superior Achromatic Photographic Combination, with Rack and Pinion, compound Condenser of 4in. diameter. Each has 3-wick Refulgent Lamp, and is Complete in box. (4-wick Lamp, 2s. extra.)



Mahogany outside Body, Panelled Door, Brass Stages, and 3-draw Sliding Tubes, so that lenses of long focus may be used when projecting upon a screen at a great distance, £5 1/2s.

Mahogany outside Body, lined with metal, making a thoroughly practical instrument, and really good value ... £2 12 0

Russian Iron Body, Brass Sliding Tubes (Educational)... 3 3 0

Do. do. (College) ... 2 8 0

PERKEN, SON & RAYMENT, 99 HATTON GARDEN, HOLBORN CIRCUS, E.C. LONDON.



THE
"HARRIS"
MICROSCOPE.

With Rackwork, £4 5 0
Without " £3 12 6

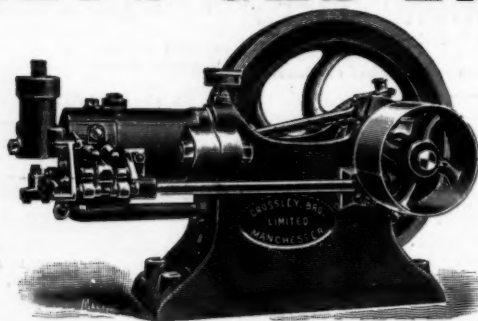
This is a first-class Microscope at a moderate price; it has fine adjustment of best design. Base is solid and rigid, and is designed for comfort in use. Complete with 2 Mirrors, Rotating Diaphragm, Eye-piece, 2 Achromatic Object Glasses, 1" giving 140 to 280 diameters and 1" giving 40 to 85 diameters. Draw Tube, Standard Screws.

The whole packed in Polished Mahogany Case.

If with 1" instead of 1", £3 17s. 6d. Giving 170 to 340 diameters.

PHILIP HARRIS & CO., LTD., Chemical & Physical Apparatus Makers, BIRMINGHAM.
CROSSLEY'S GAS ENGINES.

RECENTLY
REMODELLED.



GREAT
REDUCTION
IN
GAS
CONSUMED.

CROSSLEY BROS., LTD., OPENSHAW, MANCHESTER.
WATSON'S NEW MICROSCOPES AND APPARATUS.



WATSON'S HOLOSCOPIC EYEPIECES, for use with either APOCHROMATIC or ACHROMATIC OBJECTIVES, an adjustment being provided to the special lenses employed, for altering the correction. There is no sacrifice of efficiency, the performance being equal to the most expensive Compensating or Huyghenian Oculars.

Magnifying Powers—

6 in. tube length, 5, 7, 10, and 14 diameters.
10 in. " 7, 10, 14, and 20 "

PRICE, in Student's Size and Pattern, either power, 17/6 each.

For Full Particulars see Supplemental List, Post Free.

W. WATSON & SONS (Established 1837), Opticians to H.M. Government.

313 HIGH HOLBORN, LONDON, W.C. New Branch Now Open: 16 FORREST ROAD, EDINBURGH. And at 78 Swanston Street, Melbourne Australia. Awarded 39 Gold and other Medals at the principal International Exhibitions of the World.

WATSON'S PARACHROMATIC OIL IMMERSION CONDENSER.

Total aperture, 1.30; applanatic aperture exceeds 1.75. Undoubtedly the finest Condenser obtainable for high-power work. Optical part only ... £5 0 0

Completely mounted with Iris Diaphragm and Set of Stops ... £6 10 0

WATSON'S "SCHOOL" MICROSCOPE, New Model, complete with 1 in. Objective, in Case ... £3 3 0

WATSON'S "ROYAL" MICROSCOPE. A new model high-class instrument.

WATSON'S "FRAM" MICROSCOPE. A highest-class instrument at a very moderate cost.

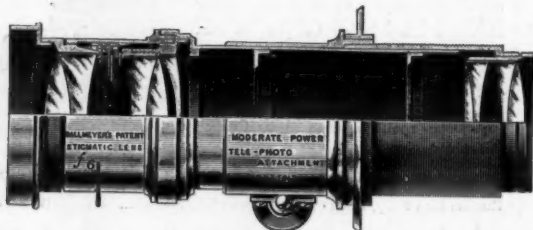
BACTERIOLOGICAL APPARATUS. MICROTOMES. Apparatus for

FIELD BOTANY and FIELD GEOLOGY. METAMORPHOSES and DISSECTED PREPARATIONS. BOTANICAL and PHYSIOLOGICAL MODELS.

For Particulars of all the above, see Watson's New Supplemental List to Catalogue No. 2, Post Free on application.

Watson's Catalogue (No. 3) is a Classified List representing a Stock of 40,000 first-class Micro-Slides, Post free on application.

DALLMEYER'S TELE-PHOTO. LENSES & ATTACHMENTS



Enable you to take Photographs of Distant or Inaccessible Subjects of sufficient size to be of practical value. Indispensable to Geologists, Naturalists, and Architects.

Price from £3 15s.

Prices and Particulars on application. Estimates and advice free.

Stigmatic Lens fitted with Tele-Photo. Attachment.
(These Attachments can be fitted to any good Lens.)

J. H. DALLMEYER, Ltd.,
25 Newman Street, London, W.

Printed by RICHARD CLAY AND SONS, LIMITED, at 7 & 8 Bread Street Hill, Queen Victoria Street, in the City of London and published by MACMILLAN AND CO., LIMITED, at St. Martin's Street, London, W.C., and THE MACMILLAN COMPANY, 66 Fifth Avenue, New York.—THURSDAY, Nov. 2, 1899.



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 1567, VOL. 61]

THURSDAY, NOVEMBER 9, 1899.

[PRICE SIXPENCE.

Registered as a Newspaper at the General Post Office.]

[All Rights are Reserved.

THE TRANSVAAL AND THE WAR.

NEW LANTERN SLIDES. Plain Slides, 12. each.

- | | |
|------------------------------------|------------------------------------|
| 1 Map of South Africa. | 26 Camping out before Nachtmal. |
| 2 Bloemfontein : General View. | 27 Mafeking Stage Coach. |
| 3 " Market Square. | 28 Transvaal Gold Diggings. |
| 4 Cattle Farm near Newcastle. | 29 Bronk-horst Spruit. |
| 5 Group of Kaffirs and Kraal. | 30 Portrait of President Kruger. |
| 6 Crossing a Drift in Ox Waggon. | 31 President Kruger's House. |
| 7 Boer Family. | 32 Major Wilson's Last Stand. |
| 8 Delagoa Bay. | 33 Fiebreit Etana at Laing's Nek. |
| 9 Durban : Landing Stage. | 34 Burial Ground at Laing's Nek. |
| 10 Durban : Town Hall. | 35 Summit of Majuba Hill. |
| 11 " West Street. | 36 Majuba Graves. |
| 12 Johannesburg : The Reef. | 37 Elandsfontein Junction. |
| 13 " The Main Reef. | 38 Jameson's Raid: the Last Stand. |
| 14 " The Hospital. | 39 Sir George White, V.C. |
| 15 " The Market. | 40 Sir Redvers Buller, V.C. |
| 16 Kimberley : View of the Rail. | 41 President Kruger at Home. |
| 17 " Market Square. | 42 Boers. Outspan on the Trek.— |
| 18 " Diamond Mine. | 43 Examining the New Rifles. |
| 19 " De Beers Mine. | 44 Boer Commando leaving by Rail. |
| 20 " Compound. | 45 Field Cornet delivering Orders. |
| 21 " Searching Nigger | 46 In the Drakensburg Range. |
| for Diamonds. | 47 Colonel Baden Powell. |
| 22 Barberton. | 48 Ladysmith : General View. |
| 23 Natal Harbour. | 49 Boer Commando on March. |
| 24 Port Elizabeth, Main Street. | 50 Charlestown Tunnel and Train. |
| 25 Pretoria: Government Buildings. | 51 Map of the Seat of War. |

This List will be added to.

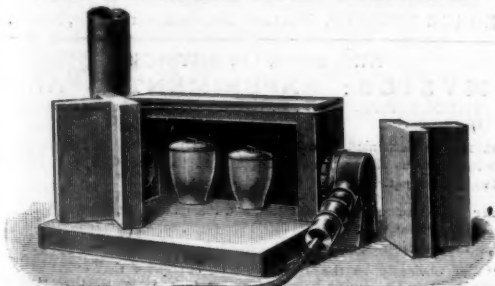
Full detailed List of Lanterns and Slides on application, Six Stamps.

NEWTON & CO., 3 FLEET STREET, E.C.

A NEW GAS FURNACE

(Holloway's Patent)

FOR CHEMISTS AND ASSAYERS.



PARTS SEPARATE. LESS CRACKING.

All particulars from SOLE MAKERS:

JOHN J. GRIFFIN & SONS, L.D.
20-26 SARDINIA STREET, LONDON W.C.

SELECTED FROM

MR. MURRAY'S UNIVERSITY EXTENSION MANUALS.

Edited by Prof. KNIGHT, of St. Andrews University.

THE STUDY OF ANIMAL LIFE. By

J. ARTHUR THOMSON, Regius Professor of Natural History in the University of Aberdeen. With many Illustrations. 5s.

THE REALM OF NATURE: A Manual

of PHYSIOGRAPHY. By Dr. HUGH ROBERT MILL, Librarian to the Royal Geographical Society. With Nineteen Coloured Maps and Sixty-eight Illustrations. 5s.

AN INTRODUCTION TO MODERN

GEOLOGY. By R. D. ROBERTS. With Coloured Maps and Illustrations. 5s.

THE PHYSIOLOGY OF THE SENSES.

By JOHN M'KENDRICK, Professor of Physiology in the University of Glasgow; and Dr. SNODGRASS, Physiological Laboratory, Glasgow. 4s. 6d.

THE ELEMENTS OF ETHICS. By JOHN

H. MUIRHEAD, Balliol College, Oxford, Lecturer on Moral Science Royal Holloway College; Examiner in Philosophy to the University of Glasgow. 3s.

LOGIC, INDUCTIVE AND DEDUCTIVE.

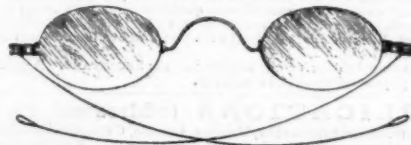
By WILLIAM MINTO, late Professor of Logic and Literature, University of Aberdeen. 4s. 6d.

* A Complete List of the above Series can be had Post free on application. JOHN MURRAY, ALBEMARLE STREET, W.

SPECTACLES

FOR
ELECTRIC LIGHT, INCANDESCENT GAS.

And other Powerful Illuminants.



NEGRETTI & ZAMBRA'S THERMOSCOPIC LENSES

Protect the Eyes from Glare, and

RENDER THE LIGHT SOFT AND COOL.

Illustrated Price Lists of Optical and Meteorological Instruments, Free by Post to all parts of the World.

NEGRETTE AND ZAMBRA,
SCIENTIFIC INSTRUMENT MAKERS to THE QUEEN,
38 HOLBORN VIADUCT, E.C.

BRANCHES: 45 CORNHILL 122 REGENT STREET.

LIVERPOOL SCHOOL OF TROPICAL MEDICINE

IN CONNECTION WITH
UNIVERSITY COLLEGE AND ROYAL
SOUTHERN HOSPITAL.

Lecturer ... MAJOR ROSS, late I.M.S.

For prospectus and all particulars, apply to A. H. MILNE, B.A., Hon. Sec., Chamber of Commerce, Liverpool.

Telegrams—"Tunzelmann, London."

THE ELECTRICAL

AND

GENERAL ENGINEERING COLLEGE.

PRESIDENT—G. W. DE TUNZELMANN, B.Sc. Lond., M.I.E.E.

PRINCIPAL—J. H. REEVES, M.A. Cantab.

Next SESSION begins WEDNESDAY, SEPTEMBER 27.

Particulars on application to the SECRETARY, 2 and 4 Penywern Road, Earl's Court, S.W.

B.A. AND B.Sc.

MATRICULATION, INTERMEDIATE, FINAL.

PREPARATION by CORRESPONDENCE and ORAL TUITION on a THOROUGHLY INDIVIDUAL SYSTEM. Fees based on success.

The STAFF includes Graduates of Oxford, Cambridge, London, and Royal Universities, Science Medalists, Prizemen, Scholars, &c.

SINGLE SUBJECTS TAKEN: Latin, Greek, French, German, Mathematics, Science, Logic, Psychology, Political Economy, &c.

For Terms, &c., address Mr. J. CHARLSTON B.A. (Lond. and Oxon.), The Burlington Classes, 27 Chancery Lane, London, W.C.

QUERNMORE. LONDON BRANCH at 24 CHANCERY LANE, W.C.

Tuition by JOHN GIBSON, M.A. (First Class, Camb.), and G. LOLL, B.A. (First Class, London), for all Public Examinations. Special Instruction in Scientific Agriculture for successful practical Agriculture and Forestry in the British Islands or the Colonies; also in Chemistry, Physics, Geology, Botany, &c. Practical Chemical and Physical Laboratories. The "State Correspondent" and Higher Examination Journal gives up-to-date particulars of all the leading C.S. and other Examinations. Price 2d., post free. Prize of One Guinea for competition each month; Special Prize of Five Guineas each June and December.

HEATHCOTE SCIENCE LABORATORIES.

These Laboratories are open for RESEARCH work, at any hours or times most convenient for worker, in Chemistry, General Physics and Bacteriology. Commercial processes can be worked out in Chemistry and Electricity, and powerful Currents, Constant or Alternating, can be used.

Eight feet of Bench fitted with Sink and Cupboard, Electricity, Gas, Water and Exhaust, £3 3s. for one month.

Private room, with same fittings, £14 14s. 6d. for one month.

The above include use of all ordinary Glass and other Apparatus and use of Accurate Balances, and other Standard General Instruments, also Furnaces, &c.

For further particulars apply, THE DIRECTOR, Heathcote Science Laboratories, 9 Heathcote Street, Gray's Inn Road, W.C.

CITY OF LONDON SCHOOL.

WANTED a PHYSICAL SCIENCE MASTER, to attend about thirty hours a week, to give instruction in Physical Science and in Mathematics.

The Salary will be £300 a year, increasing to £450 a year. Candidates for the appointment are requested to forward their applications, accompanied with a copy of testimonials as to qualification and character, not later than Tuesday, the 21st of November next, to A. J. AUSTIN, Secretary, at the School, Victoria Embankment, E.C. Selected candidates will be duly communicated with.

Forms of application can be obtained of the SECRETARY. A gentleman not over 35 years of age will be required.

APPLICATIONS (addressed to the

MINISTER OF EDUCATION, Toronto, Ontario, Canada) will be received up to January 1, 1900, for the position of PROFESSOR OF CHEMISTRY in the University of Toronto. The Salary attached to the position is 2500 dols., rising by annual increments to 3200 dols.

For further particulars address Dr. W. H. PIKE, care of the High Commissioner for Canada, London, E.C., or the PRESIDENT, University of Toronto, Toronto.

October, 1899.

ROYAL COLLEGE OF SCIENCE, DUBLIN.

DEMONSTRATOR in CHEMISTRY and ASSAYING required in Department under Professor HARTLEY, F.R.S. Salary, £90.

Applications, with copies of testimonials, to be addressed to the SECRETARY.

November 23, 1899.

TECHNICAL COLLEGE, HUDDERSFIELD.

PRINCIPAL—S. G. RAWSON, D.Sc.

Applications are invited, not later than November 13, for the newly-founded Lectureship in Latin and Greek. Salary £150 per annum. Further particulars may be obtained upon application.

THOS. THORP, Secretary.

FOR SALE, at greatly Reduced Prices, the

Contents of a Chemical Laboratory, the property of a Gentleman retiring from professional work. To be seen at Messrs. J. GRIFFIN AND SONS, Sardinia Street, Lincoln's Inn Fields, London.

SCIENCE EXAMINATIONS. LONDON UNIVERSITY.

Well-equipped LABORATORIES, DAY AND EVENING. Personal or Class Tuition.

"R," 9 Heathcote Street, Gray's Inn Road, W.C.

THE

LIBRARY OF USEFUL STORIES.

JUST PUBLISHED.

The Story of the Wanderings of Atoms,

especially those of Carbon. By M. M. PATTISON MUIR, M.A., Fellow and Prælector in Chemistry, of Gonville and Caius College, Cambridge. Price One Shilling.

BY THE SAME AUTHOR.

The Story of the Chemical Elements.

Price One Shilling.

"One of the most perfect popular introductions to science extant."—*British Medical Journal*.

RECENTLY PUBLISHED.

The Story of Ice in the Present and Past.

By W. A. BREND. With 37 Illustrations.

The Story of the British Race.

By JOHN MUNRO. With 4 Maps.

The Story of the Mind.

By Professor J. M. BALDWIN.

The Story of Geographical Discovery:

How the World became known. By JOSEPH JACOBS. With 24 Maps.

* * Complete List of the Series on application to the Publishers,

GEORGE NEWNES, LIMITED, Southampton Street, Strand.

NEW BOOK ON PHYSICS.

PHYSICS: EXPERIMENTAL AND THEORETICAL. By R. H. JUDE; and partly from the French of H. GOSSIN.

VOLUME I.—Mechanics, Hydrostatics, Pneumatics, Heat and Acoustics. With numerous Illustrations, Examples, and Exercises. 927 pp. Demy 8vo, 12s. 6d. net.

Also issued in Parts, viz. :—

PART I.—Mechanics, Hydrostatics, and Pneumatics, 3s. 6d. net.

" II.—Heat, 7s. 6d. net.

" III.—Acoustics, 2s. 6d. net.

"Will obviously be the best class-book of physics that exists in the language. . . . Dr. Jude's handling of his task, vigorous, thorough, is such that it would be difficult to imagine anything more clear and effective. It displays upon every page the grasp and experience of a practical teacher. . . . There can be small doubt that Dr. Jude's volumes will supersede the excellent Deschanel almost as completely as Deschanel ousted the venerable Ganot."—*Newcastle Chronicle*.

CHAPMAN & HALL, LTD., London.

J. & A. CHURCHILL, PUBLISHERS.

ELEMENTARY ALGEBRA (TO QUADRATICS). By C. H. FRENCH, M.A., and G. OSBORN, M.A., Mathematical Masters at the Leys School, Cambridge, formerly Scholars of Emmanuel College, Cambridge. Crown 8vo, 3s. 6d.; or with Answers to the Examples, 4s. 6d.

A MANUAL of BOTANY. By J. Reynolds GREEN, Sc.D., F.R.S., Professor of Botany to the Pharmaceutical Society; Examiner in Botany to the University of London and the Victoria University. In Two Vols., with nearly 1200 Illustrations.

Vol. I. MORPHOLOGY AND ANATOMY. Second Edition. 7s. 6d.
Vol. II. CLASSIFICATION AND PHYSIOLOGY. 10s.

PRACTICAL PHYSIOLOGY, including HISTOLOGY, CHEMICAL and EXPERIMENTAL PHYSIOLOGY. By DE BURGH BIRCH, M.D., F.R.S.E., Professor of Physiology in the Yorkshire College of the Victoria University; Additional Examiner in Edinburgh University. With 62 Illustrations. Crown 8vo, 6s. 6d.

A HANDBOOK OF PHYSICS AND CHEMISTRY FOR THE FIRST EXAMINATION OF THE JOINT BOARD OF THE COLLEGES OF PHYSICIANS AND SURGEONS, AND ALSO FOR GENERAL USE. By HERBERT E. CORBIN, B.Sc. Lond., and ARCHIBALD M. STEWART, B.Sc. Lond. With 120 Illustrations. Crown 8vo. 6s. 6d.

PHYSICAL MEASUREMENTS. With Appendices on Absolute Electrical Measurement, &c. By Prof. F. KOHLRAUSCH, Strassburg. Translated from the Seventh German Edition by T. H. WALLER, B.A., B.Sc., and H. R. PROCTER, F.I.C., F.C.S. Third English Edition, with 91 Engravings, 8vo, 12s. 6d.

WAGNER'S MANUAL OF CHEMICAL TECHNOLOGY. Edited by Sir WILLIAM CROOKES, F.R.S. From the Thirtieth Enlarged German Edition as Remodelled by Dr. FERDINAND FISCHER. Second English Edition, with 596 Illustrations. Royal 8vo, 32s.

THE ANALYST'S LABORATORY COMPANION: a Collection of Tables and Data for Chemists and Students. By ALFRED E. JOHNSON, Assoc. R.C.S.I., F.I.C., F.C.S. Second Edition, Enlarged. Crown 8vo, cloth, 5s.; leather, 6s. 6d.

Prof. FRANK CLOWES and Prof. J. B. COLEMAN'S
ILLUSTRATED CHEMICAL HANDBOOKS

For Colleges, Organised Science Schools, and Schools generally.
PRACTICAL CHEMISTRY and QUALITATIVE ANALYSIS. Seventh Edition (May 1899). 8s. 6d.

QUANTITATIVE ANALYSIS. Fourth Edition. 10s.
ELEMENTARY PRACTICAL CHEMISTRY and QUALITATIVE ANALYSIS. (New Edition in preparation.)

INTRODUCTION TO QUANTITATIVE ANALYSIS. 4s. 6d.

ELEMENTS OF HUMAN PHYSIOLOGY. By ERNEST H. STARLING, M.D., F.R.S., Jodrell Professor of Physiology in University College, London. Third Edition, with 140 Engravings, Crown 8vo, 7s. 6d.

HUMAN NATURE, ITS PRINCIPLES AND THE PRINCIPLES OF PHYSIOGNOMY. (In Two Parts.) By PHYSICIST. Part I., 2s. Part II., 2s. 6d.

THE ELEMENTS OF HEALTH: an Introduction to the Study of Hygiene. By LOUIS C. PARKES, M.D., D.P.H., Medical Officer of Health for Chelsea, Lecturer on Public Health at St. George's Hospital. With 27 Illustrations, Post 8vo, 3s. 6d.

COOLEY'S CYCLOPÆDIA OF PRACTICAL RECEIPTS, and Collateral Information in the Arts, Manufactures, Professions, and Trades, including Medicine, Pharmacy, Domestic Economy, and Hygiene, designed as a General Book of Reference for the Manufacturer, Tradesman, and Head of a Family. Edited by W. NORTH, M.A., F.C.S. Seventh Edition, with 370 Illustrations, 2 Vols., Royal 8vo, 42s.

NEW EDITIONS OF DR. PYE CHAVASSE'S WORKS.

Price 2s. 6d. each.

ADVICE to a MOTHER on the MANAGEMENT OF HER CHILDREN. By GEORGE CARPENTER, M.D., Physician to the Evelina Hospital for Sick Children, London; Editor of *Pædiatrica*, a Journal devoted to the Diseases of Children.

ADVICE to a WIFE on the MANAGEMENT OF HER OWN HEALTH. By FANCOURT BARNES, M.D., Consulting Physician to the British Lying-in Hospital, London; Senior Physician to the Royal Maternity Charity.

* * Sale 600,000 Copies.

London: J. & A. CHURCHILL, 7 GREAT MARLBOROUGH ST.

THE QUAKER BATH CABINET

Should be in Every Home for HOT-AIR, VAPOUR, or MEDICATED BATHING PURPOSES.

Makes Clean, Healthy, Strong and Vigorous Men and Women.

NATURE'S COMPLEXION BEAUTIFIER.

Cures a Bad Cold with One Bath, Averts Fevers, La Grippe, &c.



Cures the most obstinate cases of Rheumatism, Obesity, Neuralgia, La Grippe, Malaria, Catarrh, Piles, Dropsy, all Blood, Skin, Kidney, and Nervous Troubles.

25s. each, post free,

Sent ready for immediate use.

RECOMMENDED BY THE
BEST PHYSICIANS.

Folds into 3 in. by 28 in. space; weighs 7 lbs.

These Health Baths should be taken by all persons, whether healthy or unhealthy, at least once or twice a week. They open the 5,000,000 sweat pores of the skin, and force out by Nature's method all the impure, poisonous matter which causes disease.

Soap and water simply cleanse the surface or outside of the body, while these Thermal Baths cleanse inwardly and outwardly, making the blood pure, sleep sound, skin soft, white and beautiful. They prevent disease.

Descriptive (Z) Pamphlet Post Free.

THE GEM SUPPLIES CO.,
149 FLEET STREET, LONDON, E.C.

MR. EDWARD ARNOLD'S LIST.

A TEXT-BOOK OF PHYSICAL CHEMISTRY. By Dr. R. A. LEHFELDT, Professor of Physics at the East London Technical College. Crown 8vo, Cloth, 7s. 6d.

MAGNETISM AND ELECTRICITY. By J. PALEY YORKE, of the Northern Polytechnic Institute. Crown 8vo, 3s. 6d.

ELEMENTARY NATURAL PHILOSOPHY. By ALFRED EARL, M.A., Assistant Master at Tonbridge School. With numerous Illustrations and Diagrams. Cloth, 4s. 6d.

A MANUAL OF PHYSIOLOGY. By LEONARD HILL, M.B., Lecturer in Physiology at the London Hospital Medical College. With numerous Illustrations and Diagrams. 6s.

Journal of Education.—"Mr. Hill is one of the most brilliant of our younger physiologists, and has won a deservedly high place in the scientific world by his masterly work upon the circulatory system. We have found Mr. Hill's Manual the freshest and most fascinating book upon the subject since Huxley's classic Lessons; and we regard it as the best introduction to Modern Physiology in the English language."

LECTURES ON THEORETICAL AND PHYSICAL CHEMISTRY. Part I. CHEMICAL DYNAMICS. By, Dr. J. H. VAN 'T HOFF, Professor at the University of Berlin. Translated by Dr. R. A. LEHFELDT, Professor at the East London Technical College. One vol. Demy 8vo, 12s. net.

PHYSICAL CHEMISTRY FOR BEGINNERS. By Dr. VAN DEVENTER. Translated by Dr. R. A. LEHFELDT. Crown 8vo, 2s. 6d.

CHEMISTRY FOR AGRICULTURAL STUDENTS. By T. S. DYMOND, of the County Technical Laboratory, Chelmsford. Cloth, 2s. 6d.

ELECTRICAL TRACTION. By Ernest WILSON, Wh.Sc., M.I.E.E., Professor of Electrical Engineering in the Siemens Laboratory, King's College, London. Crown 8vo, Cloth, 5s.

STEAM BOILERS. By George Halliday. With numerous Diagrams and Illustrations. 400 pages. Crown 8vo, 5s.

THE CALCULUS FOR ENGINEERS. By Prof. JOHN PERRY, F.R.S. Third Edition. Crown 8vo, Cloth, 7s. 6d.

London: EDWARD ARNOLD, 37 Bedford Street, Strand.

JAS. SWIFT & SON, MANUFACTURING OPTICIANS.



SOLELY APPOINTED TO THE A.M. DEPT.
WAR OFFICE, FOR THE SUPPLY
OF MICROSCOPES.

Patent form of Student's Microscope,
fitted with $2\frac{1}{2}$ " and $1\frac{1}{6}$ " Pan-Aplanatic
Objectives, Iris Diaphragm and Oculars,
in Case, from

£5 5s.

These Instruments we have supplied in
numbers to the following Medical Schools,
viz. St. Mary's, St. Bartholomew's, Guy's,
Middlesex, London, and St. Thomas's.

Seven Gold Medals awarded for excel-
lence of manufacture.

Catalogue on Application.

81 TOTTENHAM COURT ROAD, W.

SECOND-HAND MICROSCOPES.	
POWELL & LEALAND, No. 1, with Apparatus ...	£50
POWELL & LEALAND, No. 2, with Apparatus ...	£50
BECK British Students, 2 Eye- pieces, $8\frac{1}{4}$ " &c. ...	£5 10s.
SECOND-HAND TELESCOPES.	
COOKE Equatorial, 4-inch ...	£50
ALVAN CLARK, 8-inch ...	£250
DALLMEYER, 8-inch ...	£450
ZEISS Stand, iv.a., with Abbe condenser and triple nose- piece ...	£11 10s.
CROUCH Presentation Bino- cular Microscope ...	£55
ROSS Binocular, with appar- atus, Portable Case ...	£25
WRAY Altazimuth, 4-inch ...	£35
DALLMEYER, 3½-inch, portable equatorial stand ...	£60

ALL THE ABOVE CAN BE EXAMINED AT
C. BAKER'S, 244 High Holborn, London.

PATENTS.

JAMES G. LORRAIN, M.I.E.E., M.I.MECH.E., &c.,
CHARTERED PATENT AGENT,

Norfolk House, Norfolk Street, LONDON, W.C.

Speciality—PHYSICAL PATENTS,
OPPOSITIONS, AND AMENDMENTS.

Charges on Application.

Telephone No. 2511 GERRARD. Telegrams: "LORRAIN, LONDON."
"Patentees' Handbook" Post free on application.

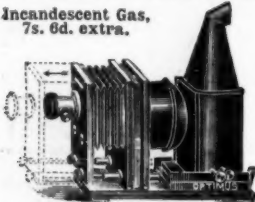
For Photography, Unsurpassed for fine definition.

COOKE LENSES

TAYLOR, TAYLOR, & HOBSON,
Stoughton Street Works, Leicester;
and 18 Berners Street, London, W.

"OPTIMUS" CANTILEVER PHOTOGRAPHIC ENLARGER.

Incandescent Gas,
7s. 6d. extra.



This already popular model
is finished in a very superior
and practical style. The lamp
gives a brilliant and even light.
The optical system is thorough-
out the best. The Lens will
be found to give a very flat
field and good marginal defini-
tion.

* SUITED FOR POCKET
CAMERA NEGATIVES.

Diam. of Condenser ...	* 4in.	5in.	6in.	8in.	10in.
Price, no Front Lens ...	6s/-	70/-	80/-	110/-	200/-
Extra for Front Lens ...	27/-	27/-	37/-	63/-	63/-
Covering Plates ...	3½ x 3½	4½ x 3½	6½ x 4½	8½ x 5½ in.	

Catalogue POST FREE.

PERKEN, SON & RAYMENT, 99 HATTON GARDEN, HOLBORN CIRCUS, E.C. LONDON.

ADAM HILGER.

OPTICAL INSTRUMENT WORKS:

204 STANHOPE STREET, LONDON, N.W.

MR. HILGER is now making the **ECHOLON DIFFRACTION GRATINGS** of Prof. MICHELSON (for full description see NATURE, April 27, 1899, or the *Astrophysical Journal* for June 1898). These Gratings have very high resolving power, together with much greater brightness than is attainable with reflection or ordinary transmission gratings. They are admirably adapted for the minute examination of fine spectral lines, or for observation of the Zeeman Effect.

Spectroscopes and Spectroscopic Accessories of all kinds for Laboratory, Stellar, or Solar Work. Prisms and Lenses of Quartz, Iceland Spar, Fluor Spar, or Rock Salt.

PRICE LIST OF THE ABOVE SENT ON APPLICATION.



CARL ZEISS,

OPTICAL WORKS, JENA.

London Branch:

29 MARGARET STREET, REGENT STREET, W.

MICROSCOPES AND ACCESSORIES
—For Bacteriology, Biology, Mineralogy and Student's use. —Achromatic, Apochromatic Objectives. —Micrometers, &c.

OPTICAL MEASURING INSTRUMENTS.—Spherometers, New Crystal Refractometer, Butter-Refractometer for the rapid determination of the purity of Butter, Lard, and Glycerine.

NOTE.—We do not make Theodolites.

Illustrated Catalogues, including new edition (1898) of Catalogue of Microscopes, free. Please state which required.

PHYSICAL AND MECHANICAL APPARATUS.

EVERETT & CO.,

Engineers and Electricians,

22 CHARTERHOUSE SQUARE, LONDON, E.C.

Scientific and Electrical Instrument Makers.

Apparatus for Laboratories, &c., designed and made to meet any requirements.

MACHINES FOR ANY SPECIAL PURPOSE BUILT TO ORDER

MODELS DESIGNED AND MADE FOR INVENTORS.

Accuracy combined with Highest Skill at Reasonable Charges.

REPAIRS OF EVERY DESCRIPTION.

"OPTIMUS" MAGIC LANTERNS FOR DRAWING ROOM AND LECTURE HALL.

Each Lantern is efficient for Exhibitions. The Lens gives crisp definition, being a superior Achromatic Photographic Combination, with Rack and Pinion, compound Condenser of 4in. diameter. Each has 3-wick Refulgent Lamp, and is Complete in box. (4-wick Lamp, 2s. extra.)



Mahogany outside Body, Panelled Door, Brass Stages, and 3-draw Sliding Tubes, so that lenses of long focus may be used when projecting upon a screen at a great distance, £5 5s.

Mahogany outside Body, lined with metal, making a thoroughly practical instrument, and really good value ... £2 12 0

Russian Iron Body, Brass Sliding Tubes (Educational)... 3 3 0

Do. do. (College) ... 2 6 0

99 HATTON GARDEN, HOLBORN CIRCUS, E.C. LONDON.

W. G. PYE & CO.

30 ST. ANDREW'S STREET, CAMBRIDGE.



PRICE £3:15:0.

Adjustment in all directions without the aid of Thumb-Screws.
EMBEDDING BATH for Mounting Specimens with Pans,
 Vials, Gas Burner Regulator, Stand, and Paraffin com-
 plete, ready for use £2 2 0
 Or **MICROTOME and BATH** together £5 13 6
 For **FLAT CUTTING** and other **MICROTOMES**, see List.

PRICE LIST of Physical and Physiological Apparatus Now Ready
 Price Sixpence, Post free.



COSSOR,
 67
 FARRINGDON RD.,
 E.C.

Original Maker of "X" RAY TUBES in England.

FOCUS TUBES giving finest possible definition. **IMPROVED TUBE**
HOLDERS, with arrangement for securing wires to avoid perforation of tube.
 All kinds of "X" Ray Apparatus, Mercury Pumps, Screens, Spark
 Gaps, &c. Applications for Price Lists invited.

TO SCIENCE LECTURERS.

HUGHES' MOTO-PHOTOSCOPE FOR LIVING PICTURES.

THE MOST PERFECT.

No SHUTTER, therefore no Flickering. Superb Mechanism.

The Moto-Photo Camera for taking the Pictures. Illustrated Lists, &c.
 See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN,
 &c. Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great
 success. New Oxyhydrogen Microscope. Science Lanterns for Class
 Demonstration. Magnificent Results. Docwra Triple, Prize Medal,
 Highest Award. Supplied to the Royal Polytechnic Institution, Dr. H. GRAT-
 TAN GUINNESS, Madame ADELINA PATTI, &c., &c. Patent Pamphengos
 Science Lanterns. The Universal Lantern 4-inch Condensers, 4-wick Lamp,
 Portrait Combination front Lenses, 18s. 6d., Marvellous value. Science
 Lecture Sets. Novelties. The Lantern Kaleidoscope. Cheapest Lantern
 Outfits in the World. Grandly Illustrated Catalogue, over 150 choice En-
 gravings, 6d.; Postage, 3d. List of 300 Lecture Sets, Science Subjects,
 Views, &c., 6d.; Postage 2d. Pamphlets Free.—W. C. HUGHES,
 SPECIALIST, Brewster House, 52 Mortimer Road, Kingsland, N.

METEOR OBSERVATIONS.

Meteor Observation Book, med. 4to, specially Ruled and
 Printed for Recording Meteor Observations in Tabular Form,
 strongly Bound and Lettered.

This Book will be found most useful as a means of recording
 all Observations in their proper order; sufficient space is
 provided for over 1000 Observations.

Price 7s. 6d.

PRINTED AND PUBLISHED BY
 WHITEHEAD, MORRIS & CO., LTD.,
 9 Fenchurch Street, London, E.C.

Just Published. With 121 Illustrations. Crown 8vo, 2s. 6d.

A PRACTICAL INTRODUCTION TO THE STUDY OF BOTANY: FLOWERING PLANTS.

By J. BRETLAND FARMER, M.A.,
 Professor of Botany in the Royal College of Science, London;
 formerly Fellow of Magdalen College, Oxford.

LONDON: LONGMANS, GREEN, & CO.

THE GEOGRAPHICAL JOURNAL.

CONTENTS.—NOVEMBER. Price 2s.

The Antarctic Expeditions. By Sir Clements Markham, K.C.B., President
 of the Royal Geographical Society of London.
 The Geographical Cycle. By William M. Davis, Professor of Physical
 Geography in Harvard University.
 Contributions to the Geography of Lake Urmi and its Neighbourhood. By
 R. T. Günthér, M.A.
 Notes on Glaciers of South-Eastern Alaska and Adjoining Territory. By
 Otto J. Klotz, Canadian Topographical Survey.
 The Swedish East Greenland Expedition. By Dr. A. G. Nathorst.
 The Seventh International Geographical Congress.
 Geography at the British Association, Dover, 1899.
 On the Physical and Chemical Work of an Antarctic Expedition. By J. Y.
 Buchanan, F.R.S.
 The Oxford School of Geography.
 The Monthly Record.
 Obituary: Chief Justice Charles P. Daly, LL.D.—William Simpson.
 Dr. Oskar Baumann.
 Correspondence: "Was Australia discovered in the Sixteenth Century?"
 By J. P. Edmond.—Andrée's Route. By Arthur Montefiore Brice.
 Geographical Literature of the Month.
 New Maps.
 Numerous Maps and Illustrations.

EDWARD STANFORD, 26-27 Cockspur Street, Charing Cross, S.W.

JUST PUBLISHED.

A HISTORY OF WIRELESS TELEGRAPHY, 1838-1899.

By J. J. FAHIE,

Member of the Institution of Electrical Engineers, London, and
 of the Société Internationale des Electriciens, Paris.

Author of "A HISTORY OF ELECTRIC TELEGRAPHY TO THE
 YEAR 1837," &c.

With Illustrations. Crown 8vo, 6s.

WILLIAM BLACKWOOD & SONS,
 EDINBURGH AND LONDON.

Williams & Norgate's Announcements.

Nearly Ready. Demy 8vo, Cloth, 13s. net.

THE LETTERS OF FARADAY AND SCHÖENBEIN, 1836-1862.

With Notes, Comments, and References to Contemporary
 Letters. Edited by GEORG W. A. KAHLBAUM and FRANCIS
 V. DARBISHIRE.

In the Press.

THE LETTERS OF BERZELIUS AND SCHÖENBEIN.

Edited by GEORG W. A. KAHLBAUM. Translated by FRANCIS
 V. DARBISHIRE and NEVILLE V. SIDGWICK.

BOOK CIRCULAR.

New Series, No. 2. Scientific Series, No. 72.

Reviews of, and Notes on New and Forthcoming Scientific
 Publications, and a List of Works on Medicine, Natural
 History, Chemistry, Physics, Mathematics, &c.

NEW AND SECOND-HAND BOOKS.—NET CASH PRICES.
 Copies sent Post free on application.

AN ESTIMATE OF THE GEOLOGICAL AGE OF THE EARTH.

By J. JOLLY, M.A., D.Sc., F.R.S., Hon. Secretary of the
 Royal Dublin Society, and Professor of Geology and Mineralogy
 in the University of Dublin.

Being the Scientific Transactions of the Royal Dublin Society,
 Volume VII., Series 2, Part 3, 4to, 44 pp. Price 1s. 6d.

WILLIAMS AND NORGATE,
 14 Henrietta Street, Covent Garden, London; 20 South
 Frederick Street, Edinburgh; and 7 Broad Street, Oxford.

NOW READY. Crown 8vo, Cloth, price 1s. 6d. net.

NEWTON'S LAWS OF MOTION.

By PROF. P. G. TAIT, M.A., Sec.R.S.E.,

Author of "Light," "Properties of Matter," and "Dynamics."

From the *Scotsman*.—"It should prove of considerable service to students in enabling them to obtain a mastery of the rudiments of their subject."

From *Literature*.—"It is something more than a text-book, and its author's name is a guarantee of its value."

NOW READY. PRICE 16s. net.

Cheap Issue in one handy volume, Demy 8vo, Cloth, 1232 pages.

A DICTIONARY OF BIRDS.

By ALFRED NEWTON, M.A., F.R.S.,

Professor of Zoology and Comparative Anatomy in the University of Cambridge.

Assisted by HANS GADOW, F.R.S. With Contributions from RICHARD LYDEKKER, B.A., F.R.S., CHARLES S. ROY, M.A., F.R.S., and ROBERT W. SHUFELDT, M.D.

Containing 340 Illustrations and a Map.

"The most comprehensive review of the subject of ornithology extant, and in it will be found a concise summary on most of the important works of ornithology from the earliest times."—*Nature*.

NOW READY. Crown 8vo, Cloth, price 6s.

RESEARCHES IN THE HISTORY OF ECONOMICS.

By PROF. E. NYS, LL.D.

TRANSLATED BY

N. F. AND A. R. DRYHURST.

"The growth of commercial and industrial Europe, the beginnings of free labour and free trade, the development of our modern system of money and banking, and the institution of modern commercial law and of the modern systems of mercantile and commercial warfare for economical supremacy, which has lasted right up to the present day—these are dealt with in the spirit of the philosophic historian in a manner that must certainly be suggestive and helpful to the student of economics."—*The Newcastle Chronicle*.

In Demy 8vo, Boards, price 3s. 6d. net.

A CLASSIFICATION OF VERTEBRATA,

RECENT AND EXTINCT.

With Diagnoses and Definitions, a Chapter on Geographical Distribution, and an Etymological Index.

By HANS GADOW, M.A., Ph.D., F.R.S.,

Strickland Curator and Lecturer on Zoology to the University, Cambridge.

"It is a book—it need hardly be said—for the student; it is simply a list of the principal sub-divisions of back-boned animals, with just as much definition as is needed. It may be regarded as an exceedingly concentrated extract of a full text-book of the vertebrates."—*The Daily Chronicle*.

Demy 8vo, Cloth, price 18s. net.

ZOOLOGY OF THE INVERTEBRATA.

A Text-Book for Students.

By A. E. SHIPLEY, M.A.,

Fellow and Assistant Tutor of Christ's College, and Demonstrator of Comparative Anatomy in the University of Cambridge.

Illustrated with 263 Figures.

"In classification, Mr. Shipley is convincing and ingenious. The book is well illustrated, well indexed, and conveniently arranged."—*Natural Science*.

A. & C. BLACK SOHO SQUARE, LONDON, W.

TWO IMPORTANT NEW WORKS.

With numerous Tables and 22 Illustrations. Just out, price 16s.

Dairy Chemistry for Dairy Managers, Chemists and Analysts:

A PRACTICAL HANDBOOK for DAIRY CHEMISTS and OTHERS HAVING CONTROL of DAIRIES.

By H. DROOP RICHMOND, F.C.S.,

Chemist to the Aylesbury Dairy Company.

SUMMARY OF CONTENTS.—I. Introductory.—The Constituents of Milk. II. The Analysis of Milk. III. Normal Milk: its Adulterations and Alterations, and their Detection. IV. The Chemical Control of the Dairy. V. Biological and Sanitary Matters. VI. Butter. VII. Other Milk Products. VIII. The Milk of Mammals other than the Cow—Appendices—Tables.

GRIFFIN'S "POCKET-BOOK" SERIES.

Leather Limp, with rounded corners and gilt edges.

NEW VOLUME NOW READY, PRICE 10s. 6d.

OUTLINES OF BACTERIOLOGY.

A PRACTICAL HANDBOOK FOR STUDENTS.

On the Basis of the "PRÉCIS DE MICROBIE."

By Dr. L. H. THOINOT, AND E. J. MASSELIN,
 Professeur agrégé à la Faculté, Médecin Vétérinaire.

Translated and Adapted for English Use, with Additions,
 By WM. ST. CLAIR SYMMERS, M.B. (Aberd.).

WITH NUMEROUS ILLUSTRATIONS, SEVERAL PRINTED IN COLOURS.

CONTENTS.—I. Glass Apparatus. II. Preparation and Sterilization—Culture Media. III. Autoclave and Incubator. IV. Experiments with Living Animals. V. VI. General Culture Methods. VII. Colouring and Staining. VIII. Microscopic Examination. Part II.—I. Diseases Common to Man and Lower Animals. II. Diseases Special to certain Higher Animals. III. Microbic Diseases peculiar to Man.

CHARLES GRIFFIN & CO., LTD.,

LONDON: EXETER STREET, STRAND, W.C.

CROMPTON & CO., LIMITED,

ELECTRICAL ENGINEERS,

Laboratory { "THRIPLANDS," } LONDON, W.
 { KENSINGTON COURT, }

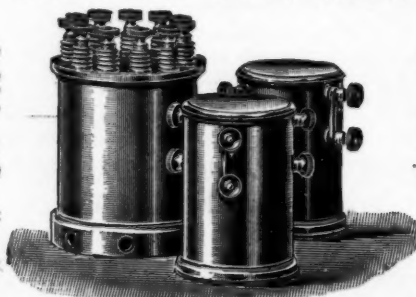
POTENTIOMETERS, GALVANOMETERS, &C.
 STANDARD (MANGANIN) RESISTANCES, BRIDGES, BOXES.
 PATENT COMPENSATED STANDARD OHMS.

SPECIAL APPARATUS BUILT TO SPECIFICATION.
 DIRECT and ALTERNATING CURRENT SETS for
 EXPERIMENTAL PURPOSES.

HIBBERT'S

ONE VOLT STANDARDS.

In Sets of 2 at £3 5 6
 " " 3 at 4 10 0



NO TEMPERATURE ERROR.]

Write for Lists, Special Quotations, &c.
 LIBERAL DISCOUNTS

DUDELL OSCILLOGRAPH.

**An Invaluable Instrument for
Alternate Current Work.**

This Galvanometer has the **shortest
periodic time of any Instrument
yet constructed**, viz. 0.0001 Second,
is **perfectly dead-beat**, and the **self-
induction is practically nil.**

WRITE FOR DESCRIPTIVE PAMPHLET.

SOLE MAKERS—

**SCIENTIFIC INSTRUMENT CO.
LIMITED,
CAMBRIDGE.**

BARGAINS IN SCIENTIFIC BOOKS.

**COUES (Professor Elliott) HANDBOOK of
FIELD AND GENERAL ORNITHOLOGY**, a Manual of the
Structure and Classification of Birds, with Instructions for Collecting
and Preserving Specimens. Illustrated. Demy 8vo, cloth (pub. 10s.),
offered at 2s. 6d.

The volume consists of two distinct parts:—

PART I.—Field Ornithology contains the necessary Instructions for the
Observation and Collection of Birds in the field, and for the Preparation
and Preservation of Specimens for scientific study in the Cabinet.

PART II.—General Ornithology is a Technical Treatise of the Classification,
the Zoological Characters, and the Anatomical Structure.

CHAPTERS.—Implements for Collecting and their Use.—Dogs.—
Suggestions and Directions for Field-work.—Hygiene of Collectors.—
Registration and Labelling.—Instruments.—Materials and Fixtures.—
How to make a Birdskin.—Collection of Nests and Eggs.—Care of a
Collection.—Definition of Birds.—Principles and Practice of Classification.—
Definitions and Descriptions of the Exterior Parts of Birds.—
An Introduction to the Anatomy of Birds.

**HEADLEY (F. W.) THE STRUCTURE
AND LIFE OF BIRDS.** By F. W. HEADLEY, M.A., F.Z.S.,
Assistant Master in Haileybury College. With 78 illustrations, crown
8vo, cloth (pub. 7s. 6d.), offered at 1s. 9d.

"We know of no book, at any rate no modern book, which covers
precisely the ground of Mr. Headley's Manual; it strengthens decidedly a
weak point in ornithological literature, and this fact, coupled with the excellence
of the illustrations, should ensure for it a wide circulation."—*Ibis*.

**BATESON (W.) MATERIALS FOR THE
STUDY OF VARIATION**, treated with especial regard to Discontinuity
in the Origin of Species. By WILLIAM BATESON, M.A.,
Fellow of St. John's College, Cambridge. 8vo, cloth (pub. 21s. net),
offered at 5s.

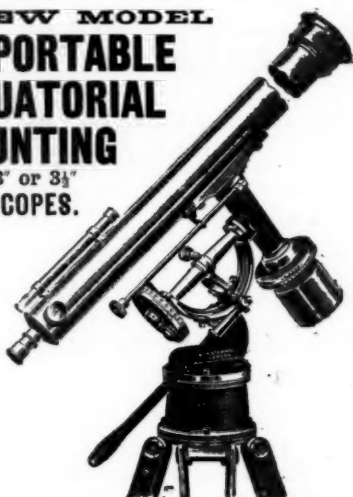
"The whole work must be carefully read by every serious student; and
there can be no question of its great and permanent value as a contribution
to our knowledge of a particular class of variations, and as a stimulus to
further work in a department of knowledge which is too much neglected."
Nature.

Postage extra.

H. J. GLAISHER, New and Remainder Bookseller, 57 Wigmore Street,
London, W.

Catalogues Post Free on application.

NEW MODEL PORTABLE EQUATORIAL MOUNTING For 3" or 3½" TELESCOPES.



Latitude Adjustment, Clamp for Declination Axis, Quick and Slow Motion, in Right Ascension.

EQUATORIAL MOUNTING with Divided Circles and Stand
fitted with short Iron Column, Levelling Screws, and Metal
Stretcher, £15 15s.; or, complete with 3" Telescope, £25.

ILLUSTRATED CATALOGUE GRATIS.

**J. H. STEWARD,
OPTICIAN,
406 STRAND, 457 WEST STRAND,
7 GRACECHURCH STREET, LONDON.**

C. E. MÜLLER & CO.,

**148 HIGH HOLBORN
LONDON, W.C.**

SCIENTIFIC GLASS BLOWING.

X-RAY TUBES

and every description of Apparatus
made to instructions.

*Lists of Chemical and Physical
Apparatus on application to above
address.*

A SCIENCE CLASSIC.

The Proprietors of NATURE have made arrangements with the Owners of the Copyright of **SOWERBY'S ENGLISH BOTANY** which enable them, for a limited time only, to supply this important and valuable Work at a greatly reduced price.

TEMPORARY PRICES OF THE THIRTEEN VOLUMES.

	CASH.	MONTHLY INSTALMENTS.
CLOTH BINDING, £16.	(Publisher's Price, £25.)	£16 16s.
HALF MOROCCO, £19.	(Publisher's Price, £27 10s.)	£19 19s.

Copies of the book may be seen at NATURE Office. An explanatory pamphlet, giving specimen pages, full contents, extracts from the preface, with a specimen hand-coloured illustration and order form, will be sent Post free on application to

C. Worsfold, NATURE Office, St. Martin's Street, London W.C.

NATURE RE-ISSUE OF SOWERBY'S ENGLISH BOTANY. THIRD EDITION WITH SUPPLEMENT.

CONTAINING A DESCRIPTION AND HAND-COLOURED

LIFE-SIZE DRAWING OF EVERY BRITISH PLANT.

"SOWERBY'S ENGLISH BOTANY":—

- (1) Is the most complete Flora of Great Britain ever brought out.—*Athenaeum*.
- (2) Has been universally accepted for nearly a century as the standard authority on descriptive English Botany.
- (3) Has been carefully revised at different times by famous men of science.
- (4) Is illustrated by **nearly two thousand beautiful hand-coloured Plates: LIFE-SIZE DRAWINGS OF EVERY BRITISH PLANT.**
- (5) Contains a technical description of each plant, with a popular sketch by Mrs. LANKESTER.
- (6) Is completed by an **index** of over **one hundred pages**, with (a) Botanical names, (b) common English names, (c) Synonyms, (d) French and German equivalents.

ORDER FORM FOR MONTHLY PAYMENTS.

Date..... 1899.

All cheques should be crossed and made payable to C. Worsfold, NATURE Office, St. Martin's Street, W.C.

I enclose One Guinea as first payment for a copy of "Sowerby's English Botany" bound in { Cloth, 16 Guineas } (cross out one of these lines), and I agree to pay to you, or to your representative, the balance at the rate of One Guinea per month; my next payment to be on the delivery of the volumes, and my remaining payments on the corresponding day of each month following. Until such payments are complete, I engage that the work, not being my property, shall not be disposed of by sale or otherwise. I further agree that if it be found impossible for any reason to deliver the book, the return of the sum of One Guinea to me shall cancel this agreement.

Name

Address

Residents abroad are kindly requested to remit in full, or to instruct their representatives in England to make the monthly payments, in order to avoid expense and delay in forwarding cash from abroad.

WATKINS & DONCASTER,

NATURALISTS,
AND MANUFACTURERS OF
CABINETS AND APPARATUS
FOR ENTOMOLOGY, BIRDS' EGGS, AND ALL BRANCHES OF
NATURAL HISTORY.

SPECIAL SHOW-ROOM FOR CABINETS.

Call or send for detailed Catalogue (66 pp.), Post free on application.

N.B.—For Excellence and Superiority of Cabinets and Apparatus, references are permitted to distinguished patrons, Museums, Colleges, &c.

A LARGE STOCK OF INSECTS AND BIRDS' EGGS.

Birds, Mammals, &c., Preserved and Mounted by First-class Workmen with true natural surroundings. All Books and Publications of Natural History supplied.

36 STRAND, LONDON. W.C.
(Five Doors from Charing Cross.)

PHYSIOGRAPHY and GEOLOGY. COLLECTIONS & MICROSCOPIC SLIDES,

As advised by Science and Art Directory, arranged by
JAMES R. GREGORY & CO.,
Mineralogists, &c.

To Science and Art Department, British, Indian and Colonial
Museums, &c.

NOVELTIES and RARE GEMS and PRECIOUS STONES.

Mineral Specimens for Museums, and Collectors, and all purposes.
Rock Specimens and Microscopic Sections of Rocks and Minerals
cut to order.

NEW AND VALUABLE MINERAL SPECIMENS CONSTANTLY
ARRIVING.

Stores & Offices: 1 Kelso Place, KENSINGTON, W.
NEW CATALOGUES AND LISTS FREE.

LIVING SPECIMENS FOR THE MICROSCOPE.

Volvox, Spirogyra, Desmids, Diatoms, Amoeba, Arcella, Actinosphaerium,
Vorticella, Stentor, Hydra, Floscularia, Stephanoceros, Melicerta, and many
other Specimens of Pond Life. Price 1s. per Tube, Post Free. Hells
gomatia, Astacus, Amphioxus, Rana, Anodon, &c., for Dissection purposes.

THOMAS BOLTON,

25 BALSALL HEATH ROAD, BIRMINGHAM.

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM.

THE LABORATORY, PLYMOUTH.

The following animals can always be supplied, either living
or preserved by the best methods:—

Sycon; Clava, Obelia, Sertularia; Actinia, Tealia, Caryophyllia, Alcyon-
ium; Hormiphora (preserved); Leptoplana; Lineus, Amphiporus; Nereis,
Aphrodite, Arenicola, Lanice, Terebella; Lepus, Balanus, Gammarus,
Ligia, Mysid, Nebalia, Carcinus; Patella, Buccinum, Eledone, Pectens
Bugula, Crisia, Pedicellina, Holothuria, Asterias, Echinus; Ascidia, Salpa
(preserved), Scyllium, Raia, &c., &c.

For prices and more detailed lists apply to
Biological Laboratory, Plymouth.

THE DIRECTOR.

ALBERT EDWARD JAMRACH

(Late CHARLES JAMRACH),

NATURALIST,

180 ST. GEORGE STREET EAST.

Implements of Savage Warfare, Idols, Sacred Masks, Peruvian Pottery,
Netsukis China, Lacquers, Gongs, Shells, and other Curios.

CO-OPERATIVE WORLD TRAVEL

Organised by HENRY S. LUNN, M.D., F.R.G.S.,
W. HOLDSWORTH LUNN, & CONNOP F.S. PEROWNE.

A Cruise to the WESTERN MEDITERRANEAN.

TILBURY, LISBON, TANGIER, GIBRALTAR, ALGIERS, PALMA,
MARSEILLES.

A FOURTEEN DAYS' CRUISE FOR £11 11s. AND UPWARDS.

A Cruise to the EASTERN MEDITERRANEAN.

(Return ticket to MARSEILLES included.)

MARSEILLES, SYRACUSE, PIRÆUS (for Athens),
CONSTANTINOPLE, JAFFA (for Jerusalem), ALEXANDRIA,
MALTA, NAPLES, MARSEILLES.

A THIRTY-FIVE DAYS' CRUISE FOR £36 15s. AND UPWARDS
s.v. ARGONAUT. Tonnage, 3254; h.-p., 4000.

Full particulars from the Secretary, 5 Endsleigh Gardens,
Euston, London, N.W.

PHŒNIX FIRE OFFICE,

19 LOMBARD ST., E.C., and 57 CHARING CROSS, S.W.

ESTABLISHED 1782.

MODERATE RATES. ABSOLUTE SECURITY.

ELECTRIC LIGHTING RULES SUPPLIED.

LIBERAL LOSS SETTLEMENTS.

PROMPT PAYMENT OF CLAIMS.

FRANCIS B. MACDONALD, SECRETARY.

LOSSES PAID OVER £22,000,000.

ESTABLISHED 1851.

BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

INVESTED FUNDS

£10,000,000.

The BIRKBECK ALMANACK, with full particulars, post free.

FRANCIS RAVENSCROFT, Manager.

OPTICAL & SCIENTIFIC INSTRUMENTS.

Spectrometers, Spectroscopes, Goniometers, Cathetometers, Optical
Benches, &c., &c. Instruments for special purposes constructed to Clients'
own designs. Price List on application.

W. WILSON (formerly Foreman at Messrs. ELLIOTT BROS.),

1 Belmont Street, Chalk Farm Road, London, N.W.

CONTRACTOR TO H.M. GOVERNMENT.

THE IRISH NATURALIST.

A Monthly Magazine of Irish Zoology, Botany, and
Geology. Price 6d.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD

PRAEGER, B.A.

Annual Subscription, 5s. Post Free to any Address.

Dublin: EASON & SON, LTD., 40 Lower Sackville Street

(to which Address Subscriptions should be sent).

London: SIMPKIN, MARSHALL, HAMILTON, KENT & CO., Ltd.

On the 1st of every Month Greatly Enlarged.

THE JOURNAL OF BOTANY.

BRITISH AND FOREIGN.

Edited by JAMES BRITTEN, F.L.S., British Museum.

CONTENTS:—Original Articles by leading Botanists.—Extracts, and
Notices of Books and Memoirs.—Articles in Journals.—Botanical News.—
Proceedings of Societies.

The enlargement has made room for many Cryptogamic and other useful
and interesting papers which have accrued since the discontinuance of
"Grevillea."

Price 1s. 3d. Subscription for One Year, payable in advance, 16s.

London: WEST, NEWMAN, & CO., 54 Hatton Garden. E.C.

BORD'S PIANOS

25 per cent. Discount for Cash, or 14/6 per month (second-hand, 10/6
month) on the Three Years' System. Lists free of

C. STILES & CO., 40 & 42 Southampton Row, London, W.C.

PIANOS EXCHANGED.

BECHSTEIN PIANOS

These magnificent Pianos for Hire on the Three Years' System at

advantageous prices and terms. Lists and particulars free of

CHAS. STILES & CO., 40 & 42 Southampton Row,
LONDON, W.C.

MACMILLAN & CO.'S BOOKS FOR STUDENTS OF CHEMISTRY.

AN INTRODUCTION to the STUDY

OF CHEMISTRY. By Prof. W. H. PERKIN, JR., Ph.D., F.R.S., and BEVAN LEAN, D.Sc., B.A. (Lond.). Globe 8vo, 2s. 6d.

CHEMISTRY FOR ORGANISED

SCHOOLS OF SCIENCE. By S. PARRISH, B.Sc., A.R.C.S. (Lond.). With Introduction by Dr. FORSYTH, Globe 8vo, 2s. 6d.

INORGANIC CHEMISTRY for BE-

GINNERS. By Sir HENRY E. ROSCOE, F.R.S. Assisted by JOSEPH LUNT, B.Sc. Globe 8vo, 2s. 6d.

INORGANIC CHEMISTRY FOR

ADVANCED STUDENTS. By Sir H. E. ROSCOE, F.R.S., and Dr. A. HARDEN. Globe 8vo, 4s. 6d.

LESSONS in ELEMENTARY CHE-

MISTRY, INORGANIC and ORGANIC. By Sir H. E. ROSCOE, F.R.S. Sixth Edition, thoroughly revised. Fcap. 8vo, 4s. 6d.

A TREATISE on CHEMISTRY. By

Sir H. E. ROSCOE, F.R.S., and the late C. SCHORLEMMER, F.R.S. New Edition. Completely revised by Sir H. E. ROSCOE, assisted by Drs. H. G. COLMAN and A. HARDEN. Vol. I. The Non-Metallic Elements. 8vo, 21s. Vol. II. The Metals, 31s. 6d. Vol. III. Organic Chemistry. Parts I., II., IV., and VI., 21s. each. Parts III. and V., 18s. each.

CHEMICAL THEORY FOR BE-

GINNERS. By LEONARD DOBBIN, Ph.D., and JAMES WALKER, Ph.D., D.Sc. Fcap. 8vo, 2s. 6d.

AN INTRODUCTION TO THE

SCIENCE and PRACTICE of QUALITATIVE CHEMICAL ANALYSIS, INORGANIC. By CHAPMAN JONES, F.I.C., F.C.S. (London and Berlin), &c. Crown 8vo, 6s.

PRACTICAL INORGANIC CHE-

MISTRY FOR ADVANCED STUDENTS. By CHAPMAN JONES, F.I.C., F.C.S. (London and Berlin). Globe 8vo, 2s. 6d.

PRACTICAL INORGANIC CHE-

MISTRY. By G. S. TURPIN, M.A., Globe 8vo, 2s. 6d.

LESSONS in ORGANIC CHEMIS-

TRY. Part I., Elementary. By G. S. TURPIN, M.A., D.Sc. 2s. 6d.

The RISE and DEVELOPMENT of

ORGANIC CHEMISTRY. By CARL SCHORLEMMER, LL.D., F.R.S. Revised Edition. Edited by A. SMITHELLS, B.Sc. Crown 8vo, 5s. net.

A TEXT-BOOK of INORGANIC

CHEMISTRY. By Prof. IRA REMSEN. 8vo, 16s.

INORGANIC CHEMISTRY. By Prof.

I. REMSEN. Crown 8vo, 6s. 6d.

ORGANIC CHEMISTRY. By Prof.

I. REMSEN. Crown 8vo, 6s. 6d.

THE ELEMENTS of CHEMISTRY.

By Prof. I. REMSEN. New Edition. Fcap. 8vo, 2s. 6d.

A JUNIOR COURSE of PRACTICAL

CHEMISTRY. By FRANCIS JONES, F.R.S.E., F.C.S. With a Preface by Sir H. E. ROSCOE, F.R.S. Eighth Edition. Globe 8vo, 2s. 6d.

AN ELEMENTARY TEXT-BOOK

OF CHEMISTRY. By Prof. W. G. MIXTER. Second Edition. Crown 8vo, 7s. 6d.

THE OWENS COLLEGE COURSE

OF PRACTICAL ORGANIC CHEMISTRY. By J. B. COHEN, Ph.D. Fcap. 8vo, 2s. 6d.

INORGANIC CHEMICAL PREPAR-

ATIONS. By FELIX LENGFELD. Globe 8vo, 2s. 6d. net.

EXPERIMENTAL PROOFS of CHE-

MICAL THEORY for BEGINNERS. By WILLIAM RAMSAY, Ph.D., F.R.S. Second Edition. Pott 8vo, 2s. 6d.

THE GASES of the ATMOSPHERE.

By WILLIAM RAMSAY, F.R.S. Extra Crown 8vo, 6s. net.

THE ELEMENTS of ELECTRO-

CHEMISTRY. By Professor MAX LE BLANC. Translated by W. R. WHITNEY. Globe 8vo, 6s.

A DICTIONARY of CHEMICAL

SOLUBILITIES, INORGANIC. By A. M. COMEY, Ph.D. Demy 8vo, 15s. net.

ANALYTICAL CHEMISTRY. By

A. MENSCHUTKIN. Translated from the third German Edition, under the supervision of the Author, by JAMES LOCKE. Medium 8vo, 17s. net.

ESSAYS in HISTORICAL CHEMIS-

TRY. By T. E. THORPE, F.R.S. Crown 8vo, 8s. 6d. net.

OUTLINES of GENERAL CHE-

MISTRY. By Prof. WILHELM OSTWALD. Translated by J. WALKER, D.Sc., Ph.D. 8vo, 10s. net.

The SCIENTIFIC FOUNDATIONS

OF ANALYTICAL CHEMISTRY TREATED IN AN ELEMENTARY MANNER. By WILHELM OSTWALD, Ph.D. Translated by GEORGE MACGOWAN, Ph.D. Crown 8vo, 5s. net.

MANUAL of PHYSICO-CHEMICAL

MEASUREMENTS. By Prof. W. OSTWALD. Translated by JAMES WALKER, D.Sc., Ph.D. Illustrated. 8vo, 7s. net.

INTRODUCTION TO PHYSICAL

CHEMISTRY. By JAMES WALKER, D.Sc., Ph.D., Professor of Chemistry in University College, Dundee. 8vo, 10s. net.

LABORATORY MANUAL EX-

PERIMENTS to ILLUSTRATE THE ELEMENTARY PRINCIPLES OF CHEMISTRY. By H. W. HILLYER, Ph.D. Medium 8vo, 4s. net.

A LABORATORY MANUAL OF

ORGANIC CHEMISTRY. By Dr. LASSAR-COHN. Translated by A. SMITH, B.Sc., Ph.D. Crown 8vo, 8s. 6d.

CHEMICAL ARITHMETIC. With

1200 Problems. By S. LUPTON, M.A. 2nd Edition, revised. Fcap. 8vo, 4s. 6d.

The ARITHMETIC of CHEMISTRY.

By JOHN WADDELL, B.Sc., Ph.D. Globe 8vo, 4s. net.

NOTES on OBSERVATIONS. Being

an Outline of the Methods used for Determining the Meaning and Value of Quantitative Observations and Experiments in Physics and Chemistry, and for reducing the results obtained. By SYDNEY LUPTON, M.A. Crown 8vo, 3s. 6d.

CHEMICAL ANALYSIS OF OILS,

FATS, WAXES, AND OF THE COMMERCIAL PRODUCTS DERIVED THEREFROM. Founded on BENEDIKT'S Second Edition of "Analyse der Fette." By J. LEWKOWITSCH, F.I.C., F.C.S. Second thoroughly revised and enlarged edition. Demy 8vo, 25s. net.

SYSTEMATIC SURVEY of THE

ORGANIC COLOURING MATTERS. By Dr. G. SCHULTZ and P. JULIUS. Translated and Edited by A. G. GREEN, F.I.C., F.C.S. Royal 8vo, 21s. net.

A HISTORY of CHEMISTRY from

EARLIEST TIMES TO THE PRESENT DAY. Being also an Introduction to the Study of the Science. By Professor ERNST VON MEYER, Ph.D. Translated by GEORGE M'GOWAN, Ph.D. Second English Edition. 8vo, 15s. net.

MACMILLAN AND CO., LIMITED, LONDON.

MACMILLAN & CO.'S NEW BOOKS.

ARCHÆOLOGICAL HANDBOOKS.—New Vols.

Edited by PROFESSOR PERCY GARDNER and PROFESSOR F. W. KELSEY.

THE ROMAN FESTIVALS OF THE PERIOD OF THE REPUBLIC: an Introduction to the Study of the Religion of the Romans. By W. WARDE FOWLER, M.A., Fellow and Sub-Rector of Lincoln College, Oxford. Extra Crown 8vo, 6s.

A HAND-BOOK OF GREEK AND ROMAN COINS. By G. F. HILL, of the Department of Coins and Medals in the British Museum. With 15 Collotype Plates. Extra Crown 8vo, 9s.

SECOND EDITION, REVISED.

ROMAN SOCIETY IN THE LAST CENTURY OF THE WESTERN EMPIRE. By SAMUEL DILL, M.A., Professor of Greek in Queen's College, Belfast. Extra Crown 8vo, 8s. 6d. net.
SPEAKER.—"The whole work is full of interest, and deserves to be widely known and carefully perused. It is a book to buy and to keep."

SEVENTH EDITION NOW READY.

A COURSE OF ELEMENTARY PRACTICAL PHYSIOLOGY AND HISTOLOGY. By Sir M. FOSTER, K.C.B., and J. N. LANGLEY, D.Sc. Seventh Edition, edited by J. N. LANGLEY, D.Sc., and L. E. SHORE, M.D. Crown 8vo, 7s. 6d.

NEW WORK BY PROFESSOR WILLIAM SMART.

THE DISTRIBUTION OF INCOME. By WILLIAM SMART, M.A., D.Phil., LL.D.; ADAM SMITH Professor of Political Economy in the University of Glasgow. Extra crown 8vo, 5s. net.

MANCHESTER COURIER.—"No epitome of the book will do justice to Dr. Smart's lucid reasoning, or convey a proper idea of the profundity of his investigation."

THE SOCIAL PHILOSOPHY OF ROBERTUS. By E. C. K. GONNER, M.A., Brunner Professor of Economic Science at University College, Liverpool. 8vo, 7s. 6d. net.

MACMILLAN AND CO., LIMITED, LONDON.

MINERALS, FOSSILS, ROCKS.

COLLECTIONS OF THIN SLICES FOR PRACTICAL MICROSCOPIC PETROGRAPHICAL STUDY

(a) Collections of Thin Slices of all important Rock-forming Minerals, for the Demonstration of the occurrence of the same in the Rocks, arranged according to F. Zirkel, "Lehrbuch der Petrographie," 2nd ed., Leipzig, 1893. Collection of 114, respectively, 60 Thin Slices.

Price, in elegant Case, £7; respectively, £3 15s.

(b) New Collection of properly mounted Thin Slices of Rock-forming Minerals, arranged according to H. Rosenbusch, "Microscopic Physiography of Minerals," 3rd ed., Stuttgart, 1897.

120 Thin Sections of 67 different Minerals in elegant Case £9 0 0
50 " " 34 " " " " " 3 10 0

(c) Collections of Thin Slices of Rocks, to which will be added a short printed description of all the Specimens and Slices, arranged according to H. Rosenbusch, "Microscopic Physiography of Rocks," 3rd ed., Stuttgart, 1896.

Collection of ... 120 180 250 Thin Slices.
Price, in elegant Case, £7 10 0 £11 5 0 £16 5 0

THE NEW CATALOGUE OF MINERALS, METEORITES, &c., has just been published, and will be sent, Post free, on application.

Dr. F. KRANTZ,

BONN-ON-THE-RHINE, RHENISH MINERAL OFFICE.

ESTABLISHED 1833.

Represented by Messrs. HARRINGTON BROS., Oliver's Yard, 53A City Road, London, E.C.; and Cork, Ireland.)

MINERALS, ROCKS & FOSSILS.

COLLECTIONS FOR STUDENTS.

Carefully labelled and arranged in Boxes with Card Trays.
50 Minerals, 12/6; 100 do., 21/; 200 do., 42/.

Rocks and Fossils at similar prices.

300 Minerals in Cabinet, £4 4s.; 400 do., £5 12s. 6d.

Catalogues Post Free.

THOMAS D. RUSSELL,
78 NEWGATE STREET, LONDON, E.C.

HOLLOWAY'S PILLS

CURE

Biliousness, Sick Headache, Indigestion, and all Internal Complaints.

CAN BE TAKEN BY THE MOST DELICATE.

Holloway's Pills and Ointment may be obtained of all Medicine Vendors.

THE MOST NUTRITIOUS.

E P P S'S

GRATEFUL—COMFORTING.

C O C O A

BREAKFAST—SUPPER.

NOTICE.—Advertisements and business letters for NATURE should be addressed to the Publishers; Editorial communications to the Editor. The telegraphic address of NATURE is "PHUSIS," LONDON.

SUBSCRIPTIONS TO "NATURE."

	£ s. d.	To ALL PLACES ABROAD:—	£ s. d.
Yearly	1 8 0	Yearly	1 10 6
Half-yearly	0 14 6	Half-yearly	0 15 6
Quarterly	0 7 6	Quarterly	0 8 0

CHARGES FOR ADVERTISEMENTS.

	£ s. d.		£ s. d.
Three Lines in Column	0 2 6	Quarter Page, or Half	
Per Line after	0 0 9	a Column	1 15 0
One Eighth Page, or Quarter		Half a Page, or a Column	3 5 0
Column	0 18 6	Whole Page	6 6 0

* The first line being in heavy type is charged for as Two Lines.

OFFICE: ST. MARTIN'S STREET, LONDON, W.C.

Charges and Money Orders payable to MACMILLAN & CO., Limited.

THE "N. & G." CAMERAS AND KINEMATOGRAPHS FOR SCIENTIFIC WORK.

High-class Instruments of best Workmanship. Used by the Leading Experts at Home and Abroad.

**COMPLETE
PHOTOGRAPHIC
OUTFITS**
Supplied for Scientific Expeditions or Special Investigations.

Catalogues and Estimates free on application.

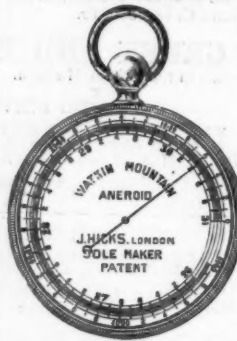
(When writing, please refer to NATURE.)



NEWMAN & GUARDIA, Ltd.,
90 & 92 Shaftesbury Avenue, London, W

JAS. J. HICKS, 8, 9 & 10 HATTON GARDEN, LONDON, SCIENTIFIC INSTRUMENT MAKER

TO THE
WAR OFFICE, INDIA OFFICE, ADMIRALTY, &c.,
IS SOLE MAKER OF THE
NEW PATENT
"WATKIN"
MOUNTAIN ANEROID
BAROMETER.



The Barometer that all the World has been waiting for, and the only Aneroid that can be thrown in and out of action as required, and which, when out of action, is absolutely impervious to the influence of variations in atmospheric pressure. Travellers and Surveyors will now be able to ascertain correct altitudes owing to the marvellous accuracy of this Instrument, which is described at length by Mr. WHYMPER, the distinguished Alpine climber, in the "Times" of Dec. 17, 1898. In 65 readings taken between 1227 and 10,289 feet above the sea, the mean error ascertained by comparison with the Mercurial Barometer was never so much as 0.1 of an inch. He says: "Extraordinary results may be obtained from Watkin's Mountain Aneroid in observations made for altitude, and in determining differences of level."

"It is beyond doubt a wonderful instrument," &c. (Press).

It is made in Aluminium for lightness, in either 3-inch or 4½-inch sizes, with Sling Leather Case, and supplied at the following prices:—Scale to 5000 feet, £5 5s. To 10,000 feet, £5 10s. To 15,000 feet, £5 15s. To 20,000 feet, £6. N.B.—Orders will be executed for this Instrument strictly in the rotation in which they are received.

Full particulars on application.

OPPOSITE THE BRITISH MUSEUM.

THACKERAY HOTEL

(TEMPERANCE),
GREAT RUSSELL STREET, LONDON.

THIS newly-erected and commodious Hotel will, it is believed, meet the requirements of those who desire all the conveniences and advantages of the larger modern licensed hotels at moderate charges. Passenger Lift. Electric Light in all Rooms. Bath-rooms on every Floor. Spacious Dining, Drawing, Writing, Reading, and Smoking Rooms. All Floors Fireproof. Perfect Sanitation. Night Porter. Telephone. Bedrooms from 2s. 6d. to 4s. 6d. per night. Full Tariff and Testimonials on application.

Telegraphic Address: "THACKERAY, LONDON."

Proprietor—J. TRUSLOVE.

Also, amalgamated with, and under the same management,

ESMOND HOTEL

(TEMPERANCE),
MONTAGUE STREET, RUSSELL SQUARE.

THIS Hotel, which has been carried on so successfully for the last 13 years, adjoins the British Museum, and is exceptionally quiet. Bedrooms from 2s. to 3s. 6d. per night. Full Tariff and Testimonials on application.

Telegraphic Address: "TRUSLOVE, LONDON."

Proprietor—J. TRUSLOVE.

THE SCIENTIFIC MAN'S, NATURALIST'S, AND TRAVELLER'S CAMERA IS THE

STEREOSCOPIC
COMPANY'S (IMPROVED
TWIN-LENS)

CARLTON.

1. It gives power to focus for any distance.
2. It has a FULL-size finder. 3. It shows the exact size of the image. 4. It has Lenses working at f/5.6. 5. It has Iris Diaphragm to working lens. 6. It has a Safety Shutter. 7. It has a pneumatic control for all speeds. 8. It gives Time and Instantaneous exposures. 9. It holds twelve Plates or Films.
10. It registers the number of Plates taken.
11. It can be used as a Stand or Hand Camera.
12. Exposed Plates can be developed without disturbing those unused.
13. It is small, light, and perfectly constructed.
14. It will stand extremes of climate.
15. It is an expert's camera.
16. Workmanship and advantages considered, it is the cheapest Twin-Lens Camera in the market.

Prices of the Twin-Lens "CARLTON."

With Euryscope Lenses, and all other advantages as detailed.

To carry Twelve Plates or Twelve Films.

4½ by 3½	£12 12s.
5 by 4	£15 15s.
6½ by 4½	£21.

Net.

FREE LESSONS TO PURCHASERS.

CATALOGUES FREE.



THE STEREOSCOPIC COMPANY,
103 & 108 REGENT STREET, W., & 54, Cheapside, E.C.



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 1568, Vol. 61]

THURSDAY, NOVEMBER 16, 1899.

[PRICE SIXPENCE.]

Registered as a Newspaper at the General Post Office.]

[All Rights are Reserved.]

THE TRANSVAAL AND THE WAR.

NEW LANTERN SLIDES. Plain Slides, 12. each.

- | | |
|------------------------------------|------------------------------------|
| 1 Map of South Africa. | 26 Camping out before Nachtmal. |
| 2 Bloemfontein: General View. | 27 Mafeking Stage Coach. |
| 3 " " Market Square. | 28 Transvaal Gold Diggings. |
| 4 Cattle Farm near Newcastle. | 29 Bronk-horst Spruit. |
| 5 Group of Kaffirs and Kraal. | 30 Portrait of President Kruger. |
| 6 Crossing a Drift in Ox Waggon. | 31 President Kruger's House. |
| 7 Boer Family. | 32 Major Wilson's Last Stand. |
| 8 Delagoa Bay. | 33 Flecreat Etona at Laing's Nek. |
| 9 Durban: Landing Stage. | 34 Burial Ground at Laing's Nek. |
| 10 Durban: Town Hall. | 35 Summit of Majuba Hill. |
| 11 " " West Street. | 36 Majuba Graves. |
| 12 Johannesburg: The Reef. | 37 Elandsfontein Junction. |
| 13 " " The Main Reef. | 38 Jameson's Raid: the Last Stand. |
| 14 " " The Hospital. | 39 Sir George White, V.C. |
| 15 " " The Market. | 40 Sir Redvers Buller, V.C. |
| 16 Kimberley: View of the Rail. | 41 President Kruger at Home. |
| 17 " " Market Square. | 42 Boers. Outspan on the Trek.— |
| 18 " " Diamond Mine. | Examining the New Rifles. |
| 19 " " De Beers Mine. | 43 Boer Commando leaving by Rail. |
| 20 " " Compound. | 44 Field Cornet delivering Orders. |
| 21 " " Searching Nigger | 45 In the Drakensburg Range. |
| for Diamonds. | 46 Colonel Baden Powell. |
| 22 Barberton. | 47 Ladysmith: General View. |
| 23 Natal Harbour. | 48 Boer Commando on March. |
| 24 Port Elizabeth, Main Street. | 49 Charlestown Tunnel and Train. |
| 25 Pretoria: Government Buildings. | 50 Map of the Seat of War. |

This List will be added to.

Full detailed List of Lanterns and Slides on application, Six Stamps.
NEWTON & CO., 3 FLEET STREET, E.C.

BECK'S NEW MICROSCOPE THE "BRITISH STUDENTS."

Microscope Stand No. 55, as figured, with Iris Diaphragm, One Eye-piece; Double Nose-piece, Two Object-glasses, 2/3" and 1/8", adjusted to be in about focus, and the whole packed in polished Mahogany Case,

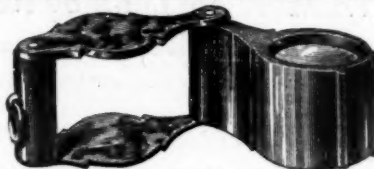
£6 : 8 : 6



No. 55.

R. & J. BECK, Ltd.,
68 CORNHILL, LONDON. E.C.

BROWNING'S PLATYSCOPIC LENS. With Larger Angles, Increased Field, and Improved Definition



Engraved Real Size.

AN ACHROMATIC COMBINATION,
COMBINING THE DEFINITION OF A MICROSCOPE WITH THE
PORTABILITY OF A POCKET LENS.

"If you carry a small Platyscopic Pocket Lens (which every observer of Nature ought to do)."—GRANT ALLEN in *Knowledge*.

The Platyscopic Lens is invaluable to botanists, mineralogists, or entomologists, as it focuses about three times as far from the object as the Coddington Lenses. This allows opaque objects to be examined easily.

The Platyscopic Lens is made of four degrees of power, magnifying respectively 10, 15, 20, and 30 diams.; the lowest power, having the largest field; is the best adapted for general use.

The Lenses are set in Ebonite Cells, and mounted in Tortoiseshell Frames. Price of the Platyscopic Lens, mounted in Tortoiseshell, magnifying either 10, 15, 20, or 30 diameters, each power, 15s.

In nickelised German Silver, each power, 17s. 6d.

Illustrated Description sent free.

JOHN BROWNING, 63 STRAND, LONDON, W.C.

SPECTACLES FOR ELECTRIC LIGHT, INCANDESCENT GAS, And other Powerful Illuminants.



NEGRETTE & ZAMBRA'S THERMOSCOPIC LENSES

Protect the Eyes from Glare, and

RENDER THE LIGHT SOFT AND COOL.

Illustrated Price Lists of Optical and Meteorological Instruments,
Free by Post to all parts of the World.

NEGRETTE AND ZAMBRA,
SCIENTIFIC INSTRUMENT MAKERS TO THE QUEEN,
38 HOLBORN VIADUCT, E.C.
BRANCHES: 45 CORNHILL; 122 REGENT STREET.

THE DAVY FARADAY RESEARCH LABORATORY OF THE ROYAL INSTITUTION.

DIRECTORS:

The Right Hon. LORD RAYLEIGH, M.A., D.C.L.
LL.D., F.R.S.

Professor DEWAR, M.A., LL.D., F.R.S.

SUPERINTENDENT OF THE LABORATORY:

DR. ALEXANDER SCOTT, M.A., D.Sc., F.R.S.

This Laboratory was founded by Dr. Ludwig Mond, F.R.S., as a Memorial of Davy and Faraday, for the purpose of promoting, by original research, the development and extension of Chemical and Physical Science.

The Laboratory is open free of charge to Workers of either sex, and any nationality, prosecuting individual investigations; and the extensive collection of Physico-Chemical Apparatus presented by the Founder is available for their use, together with such materials, chemicals, electricity, &c., as the Directors may authorise.

Assistants and a trained mechanic are attached to the Laboratory to aid Workers in the prosecution of their researches.

All persons desiring to be admitted as Workers must send evidence of scientific training, qualification, and previous experience in original research, along with a statement of the nature of the investigation they propose to undertake.

Michaelmas Term.—Monday, October 2, to Saturday, December 16.

Lent Term.—Monday, January 8, to Saturday, April 7.

Easter Term.—Monday, April 30, to Saturday, July 28.

Forms of Application can be had from the ASSISTANT SECRETARY, Royal Institution, Albemarle Street, W.

UNIVERSITY COLLEGE OF NORTH WALES. (A CONSTITUENT COLLEGE OF THE UNIVERSITY OF WALES.)

Applications are invited for the CHAIR of PHYSICS now Vacant in this College. The Council will elect on December 20th. Forty copies of the Application and Testimonials to be in the hands of the undersigned not later than Monday, December 4th. The Professor will be expected to enter on his duties at the beginning of the New Year. For further particulars apply to

JOHN EDWARD LLOYD, M.A., Secretary and Registrar.

Bangor, November 8th, 1899.

NORTHERN POLYTECHNIC INSTITUTE, HOLLOWAY, LONDON, N.

Applications are invited for the Post of CLERK to the Governing Body. The Appointment will date from the beginning of 1900. Salary £200, rising by annual increments of £10, at the discretion of the Governors, to £250.

Applications must be made not later than November 25th, on forms obtainable, with all particulars, from the PRINCIPAL at the Institute.

BOROUGH OF DERBY. MUNICIPAL TECHNICAL COLLEGE.

The Committee invite applications for the Post of LECTURER IN MATHEMATICS AND PHYSICS for Day and Evening Classes.

Salary, £200 per Annum. Applications, on Forms which may be obtained from the Registrar, should be received not later than Thursday, November 30.

F. W. SHURLOCK, B.A., B.Sc. (Principal).

THE DURHAM COLLEGE OF SCIENCE, NEWCASTLE-UPON-TYNE. LECTURER IN AGRICULTURE.

The Council invite Applications for the Post of LECTURER in AGRICULTURE. Salary, £250 per Annum and a proportion of the Fees received for County Lectures.

Applications, with testimonials, should be sent not later than DECEMBER 2, 1899, to the undersigned, from whom further particulars may be obtained.

F. H. PRUEN, Secretary.

CIVIL SERVICE COMMISSION. FORTHCOMING EXAMINATION.

ASSISTANT in the NAUTICAL ALMANAC OFFICE of the ADMIRALTY (25-28), DECEMBER 4.

The date specified is the latest at which applications can be received. They must be made on forms to be obtained, with particulars, from the SECRETARY, Civil Service Commission, London, S.W.

CITY AND GUILDS CENTRAL TECHNICAL COLLEGE, EXHIBITION ROAD, LONDON, S.W.

REQUIRED at once, an ASSISTANT in the Electrical Engineering Department to take part in the Teaching and in devising and arranging Apparatus for Lectures, and for a Junior Physical Laboratory. Salary to commence at £100 per Annum.

Apply in the first instance by letter, stating age, to Prof. AYRTON, at the College.

BIRKBECK INSTITUTION, Breems Buildings, Chancery Lane, E.C.

Science Classes with Practical Work.

DAY AND EVENING CLASSES for University of London B.Sc.; Prelim. Scientific, Inter. M.B. Examinations and for Conjoint Board, Dental and Pharmaceutical Examinations.

EVENING CLASSES in all stages for Science and Art Department Examinations.

HIGHLY-EQUIPPED LABORATORIES.

Chemistry, Physics, Biology (Zoology and Botany), Metallurgy, Geology and Mineralogy, Microscopy.

Prospectus free. Calendar 6d. (Post 8d.) on application to Secretary.

HEATHCOTE SCIENCE LABORATORIES.

These Laboratories are open for RESEARCH work, at any hours or times most convenient for worker, in Chemistry, General Physics and Bacteriology. Commercial processes can be worked out in Chemistry and Electricity, and powerful Currents, Constant or Alternating, can be used. Eight feet of Bench fitted with Sink and Cupboard, Electricity, Gas, Water and Exhaust, £3 3s. for one month.

Private room, with same fittings, £4 14s. 6d. for one month. The above includes use of all ordinary Glass and other Apparatus and use of Accurate Balances, and other Standard General Instruments, also Furnaces, &c.

For further particulars apply, THE DIRECTOR, Heathcote Science Laboratories, 9 Heathcote Street, Gray's Inn Road, W.C.

* By a printer's error in last issue this charge was made £14 14s. 6d.

B.A. AND B.Sc.

MATRICULATION, INTERMEDIATE, FINAL.

PREPARATION by CORRESPONDENCE and ORAL TUITION on a THOROUGHLY INDIVIDUAL SYSTEM. Fees based on success. The STAFF includes Graduates of Oxford, Cambridge, London, and Royal Universities, Science Medallists, Prizemen, Scholars, &c. SINGLE SUBJECTS TAKEN: Latin, Greek, French, German, Mathematics, Science, Logic, Psychology, Political Economy, &c. For Terms, &c., address Mr. J. CHARLESTON B.A. (Lond. and Oxon.), The Burlington Classes, 27 Chancery Lane, London, W.C.

Telegrams—"Tunzelmann, London."

THE GENERAL ENGINEERING COMPANY, LTD.,

2 and 4 PENYWERN ROAD, LONDON, S.W.

G. W. DE TUNZELMANN, Managing Director.

Mechanical, Electrical and Chemical Patents experimentally developed and Models constructed for Inventors. Special Machinery and Apparatus designed and carried out to Specification. Every description of Accurate work. Repetition work with all parts interchangeable.

SCIENCE EXAMINATIONS.

For LONDON and other UNIVERSITIES, the
CONJOINT BOARD, &c.

Well-equipped LABORATORIES, DAY AND EVENING. Personal or Class Tuition.

"R," 9 Heathcote Street, Gray's Inn Road, W.C.

ELEMENTARY PHYSICS TEACHING.

—Wanted at once, at the WATFORD ENDOWED SCHOOL, a MASTER to teach PHYSICS two days in the week, Wednesdays and Thursdays. An A.R. Coll. Sc. preferred. A salary of £50 per annum and Railway Fares will be paid.—Apply to the HEADMASTER.

WANTED, at once, Private Assistant, unmarried, not 25, to manage small Electrical Installation, prepare Chemistry and Physics Lectures, and keep Laboratory premises in order.—Apply, with references, to T. C. POTTER, Eio3, Windsor. Wages: £100 a year, when able to do full work.

BIUNIAL LANTERN, by Newton, with 4-inch Condensers, Mixing Jets, Polariscopes, and Crystal Stage, Mica and Quartz Specimens, Microscope, Prism Trough, Set of Mirrors, and a quantity of Apparatus, suitable to illustrate experiments mentioned in Lewis Wright's book, with Cases and Screens; late the property of a Colonel, R.E. Original cost about £100; condition as new. Full particulars by post, or can be viewed at C. BAKER'S, 244 High Holborn. Offers invited.

FOR SALE, at greatly Reduced Prices, the Contents of a Chemical Laboratory, the property of a Gentleman retiring from professional work. To be seen at Messrs. J. GRIFFIN AND SONS, Sardinia Street, Lincoln's Inn Fields, London.

BARGAINS IN SCIENTIFIC BOOKS.

COUES (Professor Elliott) HANDBOOK of FIELD AND GENERAL ORNITHOLOGY, a Manual of the Structure and Classification of Birds, with Instructions for Collecting and Preserving Specimens. Illustrated. Demy 8vo, cloth (pub. 10s.), offered at 2s. 6d.

The volume consists of two distinct parts:—

PART I.—Field Ornithology contains the necessary Instructions for the Observation and Collection of Birds in the field, and for the Preparation and Preservation of Specimens for scientific study in the Cabinet.

PART II.—General Ornithology is a Technical Treatise of the Classification, the Zoological Characters, and the Anatomical Structure.

CHAPTERS.—Implements for Collecting and their Use.—Dogs.—Suggestions and Directions for Field-work.—Hygiene of Collectors.—Registration and Labelling.—Instruments.—Materials and Fixtures.—How to make a Birdskin.—Collection of Nests and Eggs.—Care of a Collection.—Definition of Birds.—Principles and Practice of Classification.—Definitions and Descriptions of the Exterior Parts of Birds.—An Introduction to the Anatomy of Birds.

HEADLEY (F. W.) THE STRUCTURE AND LIFE OF BIRDS. By F. W. HEADLEY, M.A., F.Z.S., Assistant Master in Haileybury College. With 78 illustrations, crown 8vo, cloth (pub. 7s. 6d.), offered at 1s. 9d.

"We know of no book, at any rate no modern book, which covers precisely the ground of Mr. Headley's Manual; it strengthens decidedly a weak point in ornithological literature, and this fact, coupled with the excellence of the illustrations, should ensure for it a wide circulation."—*Ibis*.

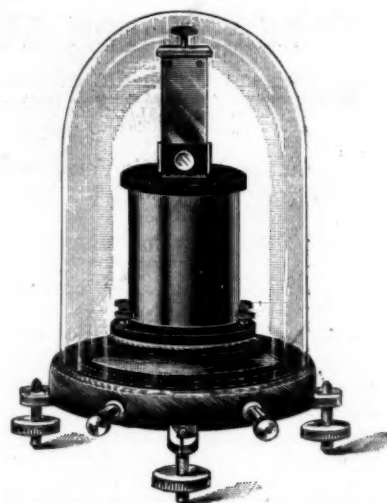
BATESON (W.) MATERIALS FOR THE STUDY OF VARIATION, treated with especial regard to Discontinuity in the Origin of Species. By WILLIAM BATESON, M.A., Fellow of St. John's College, Cambridge. 8vo, cloth (pub. 21s. net), offered at 5s.

"The whole work must be carefully read by every serious student; and there can be no question of its great and permanent value as a contribution to our knowledge of a particular class of variations, and as a stimulus to further work in a department of knowledge which is too much neglected."—*Nature*.

Postage extra.

H. J. GLAISHER, New and Remainder Bookseller, 57 Wigmore Street, London, W.

Catalogues Post Free on application.



GAMBRELL BROS.
17 GILTSPUR STREET, LONDON.

GALVANOMETER FOR SCHOOL USE.
3000 Ohms is Series 750 in parallel with Kelvin
Astatic System and Controlling Magnets.
£4 : 4 : 0.

Write for our new Price List of Electrical Test Apparatus.

WEBSTER'S INTERNATIONAL DICTIONARY OF THE ENGLISH LANGUAGE.

One Volume, Cloth, £1 11s. 6d.

The most **Practical Dictionary** extant—not too small for the man of science and the serious student—not too large for the man of affairs.

It excels in the ease with which the eye finds the word sought; in accuracy of definition; in effective methods of indicating pronunciation; and in terse and comprehensive statements of fact.

WEBSTER'S DICTIONARY has been so long and so well known that it seems superfluous to say much as to its great merits and **practical usefulness**. In order that the book may continue to deserve its success every pains have been taken to keep it thoroughly abreast with **modern scholarship**.

In the year 1891 was issued the Third Edition, which can fairly claim to be practically a new book. This edition was reprinted with corrections in 1892 and 1894, and **was revised in 1897**. Its vast superiority over former editions is attested by the following facts:—

The whole work has been reset in new type from beginning to end. The preceding edition, with all its supplementary matter, has been re-studied **line by line**.

A close comparison has been made with a whole library of the most recent works on **philology** and all branches of knowledge that include new usages of speech.

Upon **technical** subjects specialists have been employed, and their contributions have been carefully harmonised in form with the general principles of the revision.

Great care has been devoted to the **illustrations**; the number has been increased from **3000** to nearly **4000**, and about two-thirds of them are entirely new.

NATURE, in speaking of the illustrations, says:—"The pictorial illustrations are numerous and well adapted to the purposes for which they were inserted."

This Dictionary is issued in one or two volumes, bound in various styles, at prices ranging from **£1 11s. 6d.** to **£3 15s.**, according to the quality of the Binding.

A detailed Prospectus will be sent Post free on application to the Publishers.

LONDON: GEORGE BELL & SONS, YORK STREET, COVENT GARDEN.

VERLAG VON GUSTAV FISCHER IN JENA.

Das elektrische Organ des afrikanischen Zitterwelses, *Malapterurus electricus* Lacépède. Anatomisch untersucht. Von Dr. EMIL BALLOWITZ, Prof. der Anatomie in Greifswald. Mit 3 lithogr. Tafeln und 7 Holzschnitten im Text. Preis: 24 Mark.

Untersuchungen über die Vermehrung der Laubmoose durch Brutorgane und Stecklinge. Von Dr. CARL CORRENS, Prof. der Botanik. Mit 187 Abbild. Preis: 15 Mark.

Fixirung, Färbung und Bau des Protoplasmas. Kritische Untersuchungen über Technik und Theorie in der neueren Zellforschung. Von Dr. ALFRED FISCHER, Prof. der Botanik in Leipzig. Mit 1 color. Tafel und 21 Abbild. Preis: 11 Mark.

Die Bakteriologie in der Milchwirtschaft. Kurzer Grundriss zum Gebrauche für Molkebereiter, Käser und Landwirthe. Von Dr. ED. von FREUDENREICH, Vorstand des bacteriolog. Laboratoriums der Molkeereischule Rütli bei Bern. Zweite vermehrte und verbesserte Auflage. Mit 4 Abbild. Preis: 1 Mark 50 Pf.

Organographie der Pflanzen, insbesondere der Archegoniaten und Samenpflanzen, von Dr. K. GOEBEL, Prof. in München. Erster Teil. Allgemeine Organographie. Mit 130 Abbildungen. Preis: 6 Mark. Zweiter Teil. Spezielle Organographie, 1. Heft: Bryophyten. Mit 128 Abbild. Preis: 3 Mark 80 Pf.

Die Spiele der Menschen. Von KARL GROOS, Prof. der Philosophie in Basel. Preis: brosch. 10 Mark, geb. 11 Mark.

Praxis und Theorie der Zellen- und Befruchtungslehre. Von Prof. Dr. VALENTIN HÄCKER. Mit 137 Abbild. im Text. Preis: brosch. 7 Mark, geb. 8 Mark.

Die Zelle und die Gewebe. Grundzüge der Allgemeinen Anatomie und Physiologie. Von Dr. OSCAR HERTWIG, Prof. und Direktor des anat.-biologischen Instituts der Universität Berlin. Zweites Buch. Allgemeine Anatomie und Physiologie der Gewebe. Mit 89 Abbild. Preis: 7 Mark.

Die Lehre vom Organismus und ihre Beziehung zur Sozialwissenschaft. Universitätsfestrede mit erklärenden Zusätzen und Litteraturnachweisen. Von Prof. Dr. OSCAR HERTWIG. Preis: 1 Mark.

Die Elemente der Entwicklungslehre des Menschen und der Wirbelthiere. Anleitung und Repetitorium für Studierende und Aerzte, von Prof. Dr. OSCAR HERTWIG. Mit 332 Abbild. Preis: brosch. 7 Mark 50 Pf., geb. 8 Mark 50 Pf.

Die Cyclamen L., eine systematische und biologische Monographie. Von Dr. FRIEDRICH HILDEBRAND, Prof. der Botanik in Freiburg i. Br. Mit 6 lith. Tafeln. Preis: 8 Mark.

Studien über die Protoplasmaströmung bei den Characeen. Von Dr. GEORG HOERMANN. Mit 12 Abbild. Preis: 2 Mark.

Die Kontinuität der Atomverkettung, ein Strukturprinzip der lebendigen Substanz. Von Dr. GEORG HOERMANN. Mit 32 Abbild. Preis: 3 Mark.

Die Vaccinekörperchen. Nach Untersuchungen an der geimpften Hornhaut des Kaninchens. Ein experimenteller und kritischer Beitrag zur Frage nach dem Contagium der Vaccine. Von Dr. ARMAND HÜCKEL. Mit 4 lithogr. Tafeln. (Zweites Supplementheft der Beiträge zur pathol. Anatomie und zur allgemeinen Pathologie, herausg. von Prof. Dr. ZIEGLER, Freiburg.) Preis: 8 Mark.

Lehrbuch der Entwicklungsgeschichte des Menschen. Von Dr. T. KOLLMANN, Prof. der Anatomie in Basel. Mit 386 Abbild. im Text. Preis: brosch. 15 Mark, geb. 17 Mark.

Leitfaden für das Zoologische Praktikum. Von Prof. Dr. W. KÜKENTHAL. Mit 172 Abbild. Preis: brosch. 6 Mark, geb. 7 Mark.

Biomechanik, erschlossen aus dem Principe der Organese. Von Dr. ERNST MEHNERT, Prof. in Halle. Preis: 5 Mark.

Erstes mikroskopisches Practikum. Eine Einführung in den Gebrauch der Mikroskope und in die Anatomie der höheren Pflanzen. Zum Gebrauche in den botanischen Laboratorien und zum Selbstunterricht. Für Botaniker, Chemiker Pharmaceuten, Studierende des höheren Lehramtes, Zoologen. Von Dr. ARTH. MEYER, Prof. der Botanik und Pharmakognosie in Marburg. Preis: brosch. 2 Mark 40 Pf., geb. 3 Mark.

System der Bakterien. Handbuch der Morphologie, Entwicklungsgeschichte und Systematik der Bakterien. Von Dr. W. MIGULA, Prof. in Karlsruhe. Zweiter Band. Spezielle Systematik der Bakterien. Mit 18 Tafeln und 35 Textabbild. Preis: 30 Mark. Preis des vollständ. Werkes: 48 Mark.

Die Kulturgewächse der deutschen Kolonien und ihre Erzeugnisse. Für Studierende und Lehrer der Naturwissenschaften, Plantagenbesitzer, Kaufleute und alle Freunde kolonialer Bestrebungen nach dem gegenwärtigen Stande unserer Kenntnisse. Von Prof. Dr. R. SADEBECK, Direktor des botanischen Museums und des bot. Laboratoriums f. Warenkunde in Hamburg. Mit 127 Textabbild. Preis: brosch. 10 Mark, geb. 11 Mark.

Pflanzengeographie auf physiologischer Grundlage. Von Dr. A. F. W. SCHIMPER, Prof. in Basel. Mit 502 als Tafeln oder in den Text gedruckten Abbild. in Autotypie, 5 Tafeln in Lichtdruck und 4 geograph. Karten. Preis: brosch. 27 Mark, geb. 30 Mark.

Amerikanische Hexactinelliden nach dem Material der Albatross Expedition, bearbeitet von FRANZ EILHARD SCHULZE, Prof. in Berlin. Mit einem Atlas von 19 Tafeln. Preis: 48 Mark.

Zweckmässigkeit und Anpassung. Akademische Rede. Von Dr. F. W. SPENGLER, Prof. d. Zoologie in Giessen. Preis: 60 Pf.

Ueber einige Aberrationen von Papilio machaon. Von Dr. F. W. SPENGLER, Prof. der Zoologie in Giessen. Mit 3 Tafeln und 5 Textabbild. Preis: 2 Mark 50 Pf.

Ueber Reduktionstheilung, Spindelbildung, Centrosomen und Cilienbildner im Pflanzenreich. Von Dr. EDUARD STRASBURGER, Prof. der Botanik in Bonn. (Heft VI. der histologischen Beiträge.) Mit 4 lithogr. Tafeln. Preis: 10 Mark 50 Pf.

Ueber die Wirkung des neuen Tuberkulins T. R. auf Gewebe und Tuberkelbacillen. Experiment Untersuchungen. Von Dr. H. STRÜEBE, Prosector am Städtischen Krankenhaus zu Hannover. Preis: 3 Mark.

Beiträge zur Physiologie des Centralnervensystems. Von Dr. med. MAX VERWORN, Prof. d. Physiologie in Jena. Erster Teil: Die sogenannte Hypnose der Tiere. Mit 18 Abbild. Preis: 2 Mark 50 Pf.

Studien über Säugetiere. Von Dr. MAX WEBER, Prof. der Zoologie in Amsterdam. Zweiter Teil, Mit 4 Tafeln und 58 Textfiguren. Preis: 12 Mark.

Thatsachen und Auslegungen in Bezug auf Regeneration. Von AUGUST WEISMANN, Prof. in Freiburg. (Abdruck aus dem Anatomischen Anzeiger. Amtl. Organ der Anat. Gesellschaft. Herausgeg. von Prof. Dr. K. von Bardeleben in Jena. XV. Bd.) Preis: 60 Pf.

Parasitologie. Von Dr. A. WEICHSELBAUM, Prof. der Pathologischen Anatomie in Wien. Mit 78 Abbild. im Text. (Lief. 36 des Handbuchs der Hygiene herausgeg. von Th. Weyl.) Einzelpreis: 6 Mark.

Epidemiologie. Von Dr. A. WEICHSELBAUM, Prof. der Patholog. Anatomie in Wien. Mit 4 Abbild. im Text. (Lief. 37 des Handbuchs der Hygiene herausgeg. von Th. Weyl.) Einzelpreis: 5 Mark.

Grundzüge der geographisch-morphologischen Methode der Pflanzensystematik. Von Dr. R. VON WETTSTEIN, Prof. an der Deutschen Universität in Prag. Preis: 4 Mark.

Grundriss der vergleichenden Anatomie der Wirbelthiere, für Studierende bearbeitet von Dr. ROBERT WIEDERSHEIM, Prof. in Freiburg i. Br. Vierte gänzlich umgearbeitete Auflage. Mit 1 lithogr. Tafel und 361 Textabbild. in 675 Einzeldarstellungen. Preis: brosch. 14 Mark, geb. 16 Mark.

Ueber Malaria und andere Blutparasiten nebst Anhang: Eine wirksame Methode der Chromatin- und Blutfärbung. Von Dr. HANS ZIEMANN, Marinechirurg. Mit 165 farbigen Abbildungen und Photogrammen auf 5 Tafeln und 10 Fieberkurven. Preis 8 Mark 50 Pf.

VERLAG VON GUSTAV FISCHER IN JENA.

FINAL NOTICE TO READERS OF "NATURE."

This is the last chance to obtain a copy of the limited edition of the Century Dictionary issued by "The Times" at a reduction of 45 per cent. from the publishers' price. The subscription list is nearly filled, and the sale must inevitably be discontinued *on or before Monday, the 20th inst.* Orders should be sent to "The Times" *at once*, accompanied in each case by a preliminary payment of one guinea. The volumes are now ready for immediate delivery, but readers who desire to give a copy of the Century Dictionary as a Christmas Present—and it would not be easy to find a more appropriate gift—should mark their orders **"For Christmas Delivery,"** so that delivery will not be made too soon. The volumes will in such cases be delivered to the carrier with instructions to effect delivery between December 20th and 24th.

WHAT OTHER
CHRISTMAS GIFT,
AS HANDSOME AND
AS USEFUL, CAN BE
OBTAINED FOR
ONLY ONE GUINEA
IN CASH?

THE BOOK.

The Century Dictionary consists of Eight Handsome Volumes. At once an Encyclopedia of Words and a Treasury of Facts, it may be said to yield more different kinds of information than any other work of reference in the world. It is a new work on a new plan—giving, for the first time, every form of spelling, pronunciation, and usage known, whether English, American, Australian, Provincial or Colloquial.

A GREAT UNDERTAKING.

The appearance of so remarkable a production as is The Century Dictionary in its perfected form is the great literary event of our time. Since the Ninth Edition of the "Encyclopædia Britannica" was completed no comparable undertaking has been accomplished. Its 7,000 pages contain more than 600,000 Encyclopædic Definitions—many of which might, indeed, be described as articles rather than definitions—while its 300,000 Explanatory Quotations and its 7,500 Beautifully Executed Woodcuts add both to the interest and to the utility of the work.

AN OBJECT LESSON.

The majority of purchasers of "The Times" Reprint of the "Encyclopædia Britannica" paid, in the aggregate, over £20,000 more for their copies of the work than they would have paid if they had acted promptly and procured their copies at the minimum price. When "The Times" first announced its issue of the Reprint, notice was given that the price would subsequently be increased. But more than half the purchasers failed to take advantage of the temporary opportunity, and, when they did buy, paid £20,000 more for precisely the same book. Will this happen again? The Century Dictionary is now issued by "The Times" upon the same plan of sale—a plan based upon the theory that first-comers ought to get the best of the bargain. In order to avoid sharing the loss which will probably be caused by a similar delay, you need only cut out the Order blank which appears on this page and send it to the Manager of "The Times," accompanied by a cheque for One Guinea. Is it not better to do that than to wait until it is too late to profit by the best of bargains?

SPECIMEN PAGES.—A richly illustrated pamphlet containing specimen pages from THE CENTURY DICTIONARY may be had, gratis and post free, upon application to the Manager of THE TIMES.

LIMITED EDITION offered by The Times of THE CENTURY DICTIONARY: Temporary Prices.

EIGHT HANDSOME VOLUMES, 12 inches high, 9½ inches wide, 2½ inches thick.

HALF MOROCCO BINDING.
£13 in Cash.
Or 13 Monthly Payments of ONE
GUINEA each.
The Century Bookcase, 31s. 6d.

THREE-QUARTER LEVANT BINDING.
(Which we recommend.) £15 in Cash,
Or 15 Monthly Payments of ONE
GUINEA each.
The Century Bookcase, 31s. 6d.

FULL MOROCCO BINDING.
£18 in Cash.
Or 18 Monthly Payments of ONE
GUINEA each.
The Century Bookcase, 31s. 6d.

NOTE.—If the Purchaser sends a cheque for the full amount at the cash price shown above, he will effect a saving of One Shilling in the Guinea, and no Order Form need be used. The Form which follows is for the use of purchasers who prefer to make monthly payments.

ALL CHEQUES SHOULD BE DRAWN TO THE ORDER OF H. E. HOOPER.

MONTHLY PAYMENTS.—ORDER FORM.

[Date].....1899.

THE MANAGER, "THE TIMES," PRINTING HOUSE SQUARE, LONDON, E.C.

I enclose One Guinea. Please send me THE CENTURY DICTIONARY } Half Morocco, price 13 Guineas.
bound in } Three-Quarter Levant, price 15 Guineas.
} Full Morocco, price 18 Guineas. } *Strike out two of these lines.*

The balance of which sum I agree to pay you, or any one you appoint, at the rate of One Guinea a month; my next payment upon delivery of the complete 8 volumes, and my succeeding payments on the corresponding day of each month following. Until such payments are complete, I engage that the volumes, not being my property, shall not be disposed of by sale or otherwise. I further agree that if owing to unforeseen circumstances, of which you shall be the judge, the volumes cannot be delivered, the return of the deposit of One Guinea to me shall cancel this agreement.

I also enclose 31s. 6d. for THE CENTURY BOOKCASE. *Strike out if Bookcase not wanted.*

[Signed].....

NA 57

[Address].....

Please address the package to

If books are to be delivered beyond the London Postal district, the purchaser should add here the name of the railway company or shipping agent in London to whom delivery is to be made. Beyond the London postal district, carriage will be at purchaser's cost.

Detached order forms may be obtained from THE TIMES. Specimen volumes may be seen, and orders booked, at Messrs. Chappell and Co.'s, Pianoforte Manufacturers, 50 New Bond Street, or at Messrs. Street and Co.'s, 164 Piccadilly.

NOW READY. Crown 8vo, Cloth, price 1s. 6d. net.

NEWTON'S LAWS OF MOTION.

By PROF. P. G. TAIT, M.A., Sec.R.S.E.,
Author of "Light," "Properties of Matter," and "Dynamics."
From the *Scotsman*.—"It should prove of considerable service to students in enabling them to obtain a mastery of the rudiments of their subject."
From *Literature*.—"It is something more than a text-book, and its author's name is a guarantee of its value."

NOW READY. PRICE 16s. net.
Chap Issue in one handy volume, Demy 8vo, Cloth, 1232 pages.

A DICTIONARY OF BIRDS.

By ALFRED NEWTON, M.A., F.R.S.,
Professor of Zoology and Comparative Anatomy in the University of Cambridge.
Assisted by HANS GADOW, F.R.S. With Contributions from RICHARD LYDEKKER, B.A., F.R.S., CHARLES S. ROY, M.A., F.R.S., and ROBERT W. SHUFFELDT, M.D.

Containing 340 Illustrations and a Map.

"The most comprehensive review of the subject of ornithology extant, and in it will be found a concise summary on most of the important works of ornithology from the earliest times."—*Nature*.

NOW READY. Crown 8vo, Cloth, price 6s.

RESEARCHES IN THE HISTORY OF ECONOMICS.

By PROF. E. NYS, LL.D.

TRANSLATED BY
N. F. AND A. R. DRYHURST.

"The growth of commercial and industrial Europe, the beginnings of free labour and free trade, the development of our modern system of money and banking, and the institution of modern commercial law and of the modern systems of mercantile and commercial warfare for economical supremacy, which has lasted right up to the present day—these are dealt with in the spirit of the philosophic historian in a manner that must certainly be suggestive and helpful to the student of economics."—*The Newcastle Chronicle*.

In Demy 8vo, Boards, price 3s. 6d. net.

A CLASSIFICATION OF VERTEBRATA, RECENT AND EXTINCT.

With Diagnoses and Definitions, a Chapter on Geographical Distribution, and an Etymological Index.

By HANS GADOW, M.A., Ph.D., F.R.S.,
Strickland Curator and Lecturer on Zoology to the University, Cambridge.

"It is a book—it need hardly be said—for the student; it is simply a list of the principal sub-divisions of back-boned animals, with just as much definition as is needed. It may be regarded as an exceedingly concentrated extract of a full text-book of the vertebrates."—*The Daily Chronicle*.

Demy 8vo, Cloth, price 18s. net.

ZOOLOGY OF THE INVERTEBRATA.

A Text-Book for Students.

By A. E. SHIPLEY, M.A.,
Fellow and Assistant Tutor of Christ's College, and Demonstrator of Comparative Anatomy in the University of Cambridge.

Illustrated with 263 Figures.

"In classification, Mr. Shipley is convincing and ingenious. The book is well illustrated, well indexed, and conveniently arranged."—*Natural Science*.

A. & C. BLACK SOHO SQUARE, LONDON, W.

THE BRIDGES-LEE PHOTO-THEODOLITE

The most perfect Instrument invented for Survey Work in Mountainous Districts, and for Military or Rapid Surveys.

The Photo-Theodolite automatically records on the photograph all, or nearly all, the data necessary for the reduction of the photographs, including the Magnetic bearings, — thus considerably reducing the time spent and the risk of error in the interpretation of the photographs.

The Instrument is fitted with an Aluminium Body, 6-in. Azimuthal Circle, reading with Vernier to one minute of arc. 4-in. Compass, divided to half degrees. Telescope with erect and inverting Eye-pieces, rapid Rectilinear Lens with Iris Diaphragm and Colour Screen, six double dark Slides in Mahogany Case, with Stand complete, £45.

Descriptive Pamphlets and Illustrated Description of the Instrument sent free on application.

AGENT FOR RICHARD FRÈRES' AUTOMATIC RECORDING INSTRUMENTS.

L. CASELLA,
147 Holborn Bars, London, E.C.
Telegraphic Address: "Escutcheon, London." Telephone: Holborn 1054.

QUARTZ FIBRES.

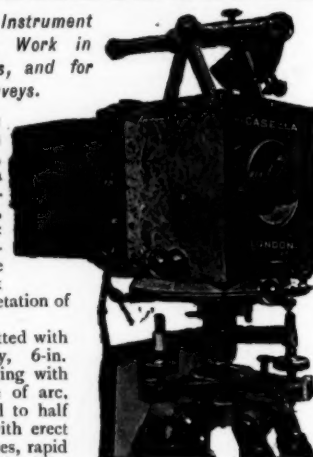
We are now making QUARTZ FIBRES about 40 cm. long, capable of supporting a weight of 50 grammes. These are especially suitable for suspending heavy magnets.

Price of Box containing 6 of these Fibres,
£1 0 0

FIBRES SUITABLE FOR GALVANOMETER SUSPENSIONS.

		s.	d.
In Box containing 6 Fibres	16 cm. long	5	0
"	30 "	7	6
"	40 "	10	0

SCIENTIFIC INSTRUMENT CO.
LIMITED,
CAMBRIDGE.

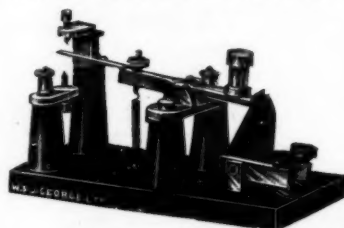


"NIVOC" SPECIALITIES.

WORKS—BIRMINGHAM.

Buy direct from the Manufacturers.

THESE INSTRUMENTS ARE SPECIALLY
SUITED FOR WORKING TOGETHER.



KEMPE'S CHARGING & DISCHARGING KEY.
Improved Form with rubbing contacts, highly
insulated, £3 15s. Highest quality and finish.
Late F. E. BECKER & CO)



"NIVOC" MOVING COIL GALVANOMETER
BALLISTIC, very sensitive. To work with $\frac{1}{2}$ Micro-
Farad Condenser, £2 10s.



STANDARD CONDENSER, $\frac{1}{2}$ Micro-
Farad, £2 12s. 6d.

STANDARD CLARK CELL, 25s. net.

W. & J. GEORGE, LTD., 33-37 HATTON WALL, LONDON.

NEW SCIENCE LANTERN.



The Universal Science Lantern has been devised for the projection of experiments. In the short box in front of the lantern is a hinged mirror, so placed that by the movement of a stud it may be introduced and placed at an angle of 45 degrees with the parallel beam. The beam is thus sent upwards through a horizontal convergent lens, on which a slide or horizontal piece of apparatus can be placed. Above this is the objective mounted on a brass pillar, and above the objective a prism or mirror (if the screen is elevated above the lantern plain prisms are required for each beam), silvered on the outside so that there is no double reflection. The mirror can be adjusted to any angle, and is intended to send the image in an approximately horizontal direction to the screen. Slides can also be directly projected in the usual way.

The base-board is made to fold so that the lantern can be packed into a box 18 $\frac{1}{2}$ x 8 $\frac{1}{2}$ x 5 $\frac{1}{2}$ with all its accessories *in situ*.

Price Complete, in Travelling Box, £9 0 0

REYNOLDS & BRANSON, LTD.
14 COMMERCIAL STREET, LEEDS.

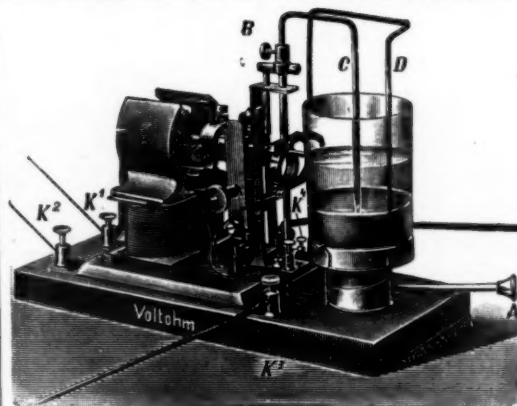
ISENTHAL, POTZLER & CO.,

85 MORTIMER STREET, LONDON, W.

Telegrams: "HYSTERESIS."

Telephone: 2099, GERARD.

CENTRAL DEPOT FOR RADIOGRAPHERS.



MERCURY BREAK.

Write for Lists, or better inspect our Installations.

HIGHEST REFERENCES.

EVERYTHING NOVEL AND ORIGINAL.

Sole Agents for Scotland:

Messrs. JAMES WHITE,
Cambridge Street, Glasgow.

PHŒNIX FIRE OFFICE,

19 LOMBARD ST., E.C., and 57 CHARING CROSS, S.W.

ESTABLISHED 1782.

MODERATE RATES. ABSOLUTE SECURITY.
ELECTRIC LIGHTING RULES SUPPLIED.

LIBERAL LOSS SETTLEMENTS.

PROMPT PAYMENT OF CLAIMS.

FRANCIS B. MACDONALD, SECRETARY.

LOSSES PAID OVER £22,000,000.

ESTABLISHED 1851.

BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

INVESTED FUNDS

£10,000,000.

The BIRKBECK ALMANACK, with full particulars, post free.

FRANCIS RAVENSCROFT, Manager.

THE MOST NUTRITIOUS.

E P P S'S

GRATEFUL—COMFORTING.

C O C O A

BREAKFAST—SUPPER.

HOLLOWAY'S OINTMENT

CURES

Gout, Rheumatism, Lumbago, Sciatica, Cuts,
Bruises, Sprains, &c.

INVALUABLE FOR ALL SKIN DISEASES.

Holloway's Ointment and Pills may be obtained of
all Medicine Vendors.

CO-OPERATIVE WORLD TRAVEL

Organised by HENRY S. LUNN, M.D., F.R.G.S.,
W. HOLDSWORTH LUNN, & CONNOP F. S. PEROWNE.

A Cruise to the WESTERN MEDITERRANEAN.

LILBURY, LISBON, TANGIER, GIBRALTAR, ALGIERS, PALMA,
MARSEILLES.

A FOURTEEN DAYS' CRUISE FOR £11 11s. AND UPWARDS.

A Cruise to the EASTERN MEDITERRANEAN.

(Return ticket to MARSEILLES included.)

MARSEILLES, SYRACUSE, PIRÆUS (for Athens),
CONSTANTINOPLE, JAFFA (for Jerusalem), ALEXANDRIA,
MALTA, NAPLES, MARSEILLES.

A THIRTY-FIVE DAYS' CRUISE FOR £36 15s. AND UPWARDS
s.y. ARGONAUT. Tonnage, 3254; h.-p., 4000.

Full particulars from the Secretary, 5 Endsleigh Gardens,
Euston, London, N.W.

TO SCIENCE LECTURERS.

HUGHES' MOTO-PHOTOSCOPE FOR LIVING PICTURES.

THE MOST PERFECT.

No SHUTTER, therefore no Flickering. Superb Mechanism.

The Moto-Photo Camera for taking the Pictures. Illustrated Lists, &c.

See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN.
&c. Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great
success. New Oxyhydrogen Microscope. Science Lanterns for Class
Demonstration. Magnificent Results. Docwra Triple, Prize Medal,
Highest Award, Supplied to the Royal Polytechnic Institution, Dr. H. GRAT-
TAN GUINNESS, Madame ADELINA PATTI, &c., &c. Patent Pamphengos
Science Lanterns. The Universal Lantern 4-inch Condensers, 4-wick Lamp,
Portrait Combination front Lenses, 16s. 6d., Marvellous value. Science
Lecture Sets. Novelties. The Lantern Kaleidoscope. Cheapest Lantern
Outfits in the World. Grandly Illustrated Catalogue, over 100 choice En-
gravings, 6d.; Postage, 3d. List of 300 Lecture Sets, Science Subjects,
Views, &c., 6d.; Postage, 2d. Pamphlets Free. W. C. HUGHES,
SPECIALIST, Brewster House, 88 Mortimer Road, Kingsland, N.

THE IRISH NATURALIST.

A Monthly Magazine of Irish Zoology, Botany, and
Geology. Price 6d.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD

PRAEGER, B.A.

Annual Subscription, 5s. Post Free to any Address.

Dublin: EASON & SON, LTD., 40 Lower Sackville Street

(to which Address Subscriptions should be sent).

London: SIMPKIN, MARSHALL, HAMILTON, KENT & CO., Ltd.

HARVEY & PEAK

HAVE FOR DISPOSAL

A VERY LARGE AND RARE PROJECTION POLARISCOPE.

Including Nicol Polariser of $3\frac{1}{2}$ inches aperture, Nicol Analyser of $3\frac{1}{4}$ inches aperture,
many large Sections of Quartz, Quartz Devices, Crystals, Double Image Prisms,
Selenites, &c., in Mahogany Cabinets.

56 CHARING CROSS ROAD, LONDON, W.C.

NOTICE.—Advertisements and business letters for NATURE should be addressed to the Publishers; Editorial
communications to the Editor. The telegraphic address of NATURE is "PHUSIS," LONDON.

SUBSCRIPTIONS TO "NATURE."

	£	s.	d.
Yearly	1	8	0
Half-yearly	0	14	6
Quarterly	0	7	6
TO ALL PLACES ABROAD:—			
Yearly	1	10	6
Half-yearly	0	15	6
Quarterly	0	8	0

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
*Three Lines in Column	0	2	6
Per Line after	0	0	9
One Eighth Page, or Quarter Column	c	18	6
Quarter Page, or Half a Column	1	15	0
Half a Page, or a Column	3	5	0
Whole Page	6	6	0

* The first line being in heavy type is charged for as Two Lines.

Cheques and Money Orders payable to MACMILLAN & CO., Limited.

OFFICE: ST. MARTIN'S STREET, LONDON, W.C.

A PHENOMENALLY SUCCESSFUL BOOK.

Illustrating and Describing the Latest
SCIENTIFIC AND TECHNICAL
APPLICATIONS OF PHOTOGRAPHY.

Including the Fascinating Process of
Three-Colour Printing,
With Coloured Charts and Specimens.
"The high order of merit attained
should not only render the book a valu-
able aid to the process worker and others
interested in the art of reproduction, but
should find many friends who would de-
light to possess such a charming collec-
tion of high-class illustrations."—*Nature*,
October 19.

PRINCIPAL AGENTS:

London: PERCY LUND, HUMPHRIES, &
CO., LTD., 3 Amen Corner, E.C.;
and at Bradford: ILIFFE, SONS &
STURMEY, LTD., 3 St. Bride St., E.C.
DARBURN & WARD, LTD., 6
Farringdon Avenue, E.C.

Price 3/6 nett.

PUBLISHERS:
PENROSE & CO., 8 and 8a Upper Baker Street, Lloyd Square, W.C.
And at Paris: 44 Rue Notre Dame des Champs.

Sale by Auction.

MONDAY NEXT.

Several Magnificent Wapiti, Moose and other Deer Heads mounted on
their own skulls in splendid condition, a grand Bison's Head, &c.;
British and Foreign Insects, and other Natural History Specimens.

MR. J. C. STEVENS will Sell the above
by Auction, at his Great Rooms, 38 King Street, Covent Garden, as
above, at 12.30 precisely.

On view the Saturday prior, 10 till 4, and Morning of Sale, and Catalogues
had.

LIVING SPECIMENS FOR
THE MICROSCOPE.

Volvox, Spirogyra, Desmids, Diatoms, Amoeba, Arcella, Actinosphaerium,
Vorticella, Stentor, Hydra, Filicula, Stephanoceros, Melicerta, and many
other Specimens of Pond Life. Price 12. per Tube, Post Free. Helix
pomatia, Astacus, Amphioxus, Rana, Anodon, &c., for Dissection purposes.

THOMAS BOLTON,

25 BALSALL HEATH ROAD, BIRMINGHAM.

MARINE BIOLOGICAL ASSOCIATION
OF THE UNITED KINGDOM.

THE LABORATORY, PLYMOUTH.

The following animals can always be supplied, either living
or preserved by the best methods:—

Sycon; Clava, Obelia, Sertularia; Actinia, Tealia, Caryophyllia, Alcyo-
onium; Horniophora (preserved); Leptoplana; Lineus, Amphiporus; Nereis,
Aphrodite, Arenicola, Lanice, Terebellia; Lepas, Balanus, Gammarus,
Ligia Myia, Nebalia, Carcinus; Patella, Buccinum, Eledone, Pecten
Bugula, Crisia, Pedicellina. Holothuria, Asterias, Echinus; Ascidia, Salpa
(preserved), Scyllium, Raia, &c., &c.

For prices and more detailed lists apply to
Biological Laboratory, Plymouth.

THE DIRECTOR.

MINERALS, ROCKS & FOSSILS.

COLLECTIONS FOR STUDENTS.

Carefully labelled and arranged in Boxes with Card Trays.

50 Minerals, 12/6; 100 do., 21/-; 200 do., 42/-.

Rocks and Fossils at similar prices.

300 Minerals in Cabinet, £4 4s.; 400 do., £5 12s. 6d.

Catalogues Post Free.

THOMAS D. RUSSELL,

78 NEWGATE STREET, LONDON, E.C.

MINERALS, ROCKS, AND PRECIOUS STONES.

Choice Minerals for Museums, Characteristic Examples for the Teacher,
Student, or Prospector.

LAPIDARIES' WORK IN ALL BRANCHES.

BLOWPIPE CASES AND APPARATUS.

LESSONS GIVEN.

SAMUEL HENSON,

97 REGENT STREET, LONDON, W.
ESTABLISHED 1840.

CAMBRIDGE UNIVERSITY PRESS.

SCIENTIFIC PAPERS. By John William

STRUTT, BARON RAYLEIGH, D.Sc., F.R.S. Honorary Fellow
of Trinity College, Cambridge, Professor of Natural Philosophy in the
Royal Institution. To be completed in (probably) 4 volumes. Vol. I.,
1869-1881, nearly ready, 15s. net.

Now Ready. Demy 8vo, 12s.

THE STRENGTH OF MATERIALS.

By J. A. EWING, M.A., F.R.S., Professor of Mechanism and
Applied Mechanics in the University of Cambridge.

By the same Author.

THE STEAM ENGINE AND OTHER

HEAT ENGINES. Demy 8vo. With Illustrations. Second Edition.
Revised and Enlarged. 15s.

"To the thoughtful student of engineering science the book is in-
valuable."—*Nature*.

"Probably no other book on the steam engine has had compressed be-
tween its two covers so much sound information in so readable a form. It
should be in every student's hands."—*Electrical Review*.

THE TEACHING OF GEOGRAPHY IN

SWITZERLAND AND NORTH ITALY. Being the Report pre-
sented to the Court of the University of Wales on a visit to Switzerland
and North Italy in 1898, as Gilchrist Travelling Student. By JOAN
BERENICE REYNOLDS, B.A., Assistant-Mistress in the Cardiff
Intermediate School for Girls. 2s. 6d.

"It is replete with valuable suggestions, and no teacher of geography
can peruse its pages without being refreshed and immensely profited
thereby."—*Practical Teacher*.

CAMBRIDGE NATURAL SCIENCE MANUALS.

Geological Series. New Volume.

CRYSTALLOGRAPHY.

By W. J. LEWIS, M.A., Professor of Mineralogy in the University
of Cambridge. Demy 8vo, 14s. net.

London: C. J. CLAY & SONS, Cambridge University Press Warehouse
Ave Maria Lane.

Now Ready, large post 8vo, cloth, 6s.

THE

EVOLUTION OF GEOGRAPHY.

A Sketch of the Rise and Progress of Geographical
Knowledge, from the Earliest Times to the First
Circumnavigation of the Globe.

By JOHN KEANE.

WITH 19 MAPS, AND SEVERAL ILLUSTRATIONS.

London: EDWARD STANFORD, 26 and 27 Cockspur
Street, S.W.,

Geographer to the Queen.

JUST PUBLISHED. 8vo. Price 15s. net.

THE

KINETIC THEORY OF GASES.

ELEMENTARY TREATISE WITH MATHEMATICAL
APPENDICES.

By DR. OSKAR EMIL MEYER,
Professor of Physics at the University of Breslau.

Translated from the Second Revised Edition by

ROBERT E. BAYNES, M.A.,

Student of Christ Church, Oxford, and Dr. Lee's Reader in Physics.

LONDON: LONGMANS, GREEN, & CO.

ALBERT EDWARD JAMRACH

(Late CHARLES JAMRACH),

NATURALIST,

180 ST. GEORGE STREET EAST.

Implements of Savage Warfare, Idols, Sacred Masks, Peruvian Pottery
Netsukis China, Lacquers, Gongs, Shells, and other Curios.

PHŒNIX FIRE OFFICE,

19 LOMBARD ST., E.C., and 57 CHARING CROSS, S.W.

ESTABLISHED 1782.

MODERATE RATES. ABSOLUTE SECURITY
ELECTRIC LIGHTING RULES SUPPLIED.

LIBERAL LOSS SETTLEMENTS.

PROMPT PAYMENT OF CLAIMS.

FRANCIS B. MACDONALD, SECRETARY.

LOSSES PAID OVER £22,000,000.

ESTABLISHED 1851.

BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

INVESTED FUNDS

£10,000,000.

The BIRKBECK ALMANACK, with full particulars, post free.

FRANCIS RAVENSCROFT, Manager.

THE MOST NUTRITIOUS.

E P P S'S

GRATEFUL—COMFORTING.

C O C O A

BREAKFAST—SUPPER.

HOLLOWAY'S OINTMENT

CURES

Gout, Rheumatism, Lumbago, Sciatica, Cuts,
Bruises, Sprains, &c.

INVALUABLE FOR ALL SKIN DISEASES.

Holloway's Ointment and Pills may be obtained of
all Medicine Vendors.

CO-OPERATIVE WORLD TRAVEL

Organised by HENRY S. LUNN, M.D., F.R.G.S.,
W. HOLDSWORTH LUNN, & CONNOP F.S. PEROWNE.

A Cruise to the WESTERN MEDITERRANEAN.

TILBURY, LISBON, TANGIER, GIBRALTAR, ALGIERS, PALMA,
MARSEILLES.

A FOURTEEN DAYS' CRUISE FOR £11 11s. AND UPWARDS.

A Cruise to the EASTERN MEDITERRANEAN.

(Return ticket to MARSEILLES included.)

MARSEILLES, SYRACUSE, PIRÆUS (for Athens),
CONSTANTINOPLE, JAFFA (for Jerusalem), ALEXANDRIA,
MALTA, NAPLES, MARSEILLES.

A THIRTY-FIVE DAYS' CRUISE FOR £36 15s. AND UPWARDS
s.v. ARGONAUT. Tonnage, 3254; h.p., 4000.

Full particulars from the Secretary, 5 Endsleigh Gardens,
Euston, London, N.W.

TO SCIENCE LECTURERS.

HUGHES' MOTO-PHOTOSCOPE FOR LIVING PICTURES.

THE MOST PERFECT.

No SHUTTER, therefore no Flickering. Superb Mechanism.

The Moto-Photo Camera for taking the Pictures. Illustrated Lists, ad.

See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN,
&c. Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great
success. New Oxyhydrogen Microscope. Science Lanterns for Class
Demonstration. Magnificent Results. Docwra Triple, Prize Medal,
Highest Award. Supplied to the Royal Polytechnic Institution, Dr. H. GRAY-
SON GUINNESS, Madame ADELINA PATTI, &c., &c. Patent Pamphlets
Science Lanterns. The Universal Lantern 4-inch Condensers, 4-wick Lamp,
Portrait Combination front Lenses, 18s. 6d., Marvellous value. Science
Lecture Sets. Novelties. The Lantern Kaleidoscope. Cheapest Lantern
Outfits in the World. Grandly Illustrated Catalogue, over 180 choice En-
gravings, 6d.; Postage, 3d. List of 300 Lecture Sets, Science Subjects,
Views, &c., 6d.; Postage ad. Pamphlets Free. W. C. HUGHES,
SPECIALIST, Brewster House, 82 Mortimer Road, King'sland, N.

THE IRISH NATURALIST.

A Monthly Magazine of Irish Zoology, Botany, and
Geology. Price 6d.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD
PRAEGER, B.A.

Annual Subscription, 5s. Post Free to any Address.

Dublin: EASON & SON, LTD., 40 Lower Sackville Street
(to which Address Subscriptions should be sent).

London: SIMPKIN, MARSHALL, HAMILTON, KENT & CO., Ltd.

HARVEY & PEAK

HAVE FOR DISPOSAL

A VERY LARGE AND RARE PROJECTION POLARISCOPE.

Including Nicol Polariser of $3\frac{1}{2}$ inches aperture, Nicol Analyser of $3\frac{1}{4}$ inches aperture,
many large Sections of Quartz, Quartz Devices, Crystals, Double Image Prisms,
Selenites, &c., in Mahogany Cabinets.

56 CHARING CROSS ROAD, LONDON, W.C.

NOTICE.—Advertisements and business letters for NATURE should be addressed to the Publishers; Editorial
communications to the Editor. The telegraphic address of NATURE is "PHUSIS," LONDON.

SUBSCRIPTIONS TO "NATURE."

	£	s.	d.
Yearly	1	8	0
Half-yearly	0	14	6
Quarterly	0	7	6
TO ALL PLACES ABROAD:—			
Yearly	1	10	6
Half-yearly	0	15	6
Quarterly	0	8	0

Cheques and Money Orders payable to MACMILLAN & CO., Limited.

OFFICE: ST. MARTIN'S STREET, LONDON, W.C.

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
*Three Lines in Column	0	2	6
Per Line after	0	0	9
One Eighth Page, or Quarter Column	0	18	6
Quarter Page, or Half a Column	1	15	0
Half a Page, or a Column	3	5	0
Whole Page	6	6	0

* The first line being in heavy type is charged for as Two Lines.

A PHENOMENALLY SUCCESSFUL BOOK.

Illustrating and Describing the Latest
SCIENTIFIC AND TECHNICAL
APPLICATIONS OF PHOTOGRAPHY.

Including the Fascinating Process of
Three-Colour Printing,
With Coloured Charts and Specimens.
"The high order of merit attained
should not only render the book a valuable
aid to the process worker and others
interested in the art of reproduction, but
should find many friends who would de-
light to possess such a charming collection
of high-class illustrations."—*Nature*,
October 19.

PRINCIPAL AGENTS:
London: PERCY LUND, HUMPHRIES, &
Co., LTD., 3 Amen Corner, E.C.;
and at Bradford, LUIPS, SONS &
STURMEY, LTD., 3 St. Bride St., E.C.
Dawbarn & Ward, LTD., 6
Farringdon Avenue, E.C.

Price 3/6 nett.

PUBLISHERS:
PENROSE & CO., 8 and 8a Upper Baker Street, Lloyd Square, W.C.
And at Paris: 44 Rue Notre Dame des Champs.

Sale by Auction.

MONDAY NEXT.

Several Magnificent Wapiti, Moose and other Deer Heads mounted on
their own skulls in splendid condition, a grand Bison's Head, &c.;
British and Foreign Insects, and other Natural History Specimens.

MR. J. C. STEVENS will Sell the above
by Auction, at his Great Rooms, 38 King Street, Covent Garden, as
above, at 12.30 precisely.

On view the Saturday prior, to till 4, and Morning of Sale, and Catalogues
had.

LIVING SPECIMENS FOR
THE MICROSCOPE.

Volvox, Spirogyra, Desmids, Diatoms, Amoeba, Arcella, Actinosphaerium,
Vorticella, Stentor, Hydra, Filicula, Stephanoceros, Melicerta, and many
other Specimens of Pond Life. Price 1s. per Tube, Post Free. Helix
pomatia, Astacus, Amphioxus, Rana, Anodon, &c., for Dissection purposes.

THOMAS BOLTON,

25 BALSALL HEATH ROAD, BIRMINGHAM.

MARINE BIOLOGICAL ASSOCIATION
OF THE UNITED KINGDOM.

THE LABORATORY, PLYMOUTH.

The following animals can always be supplied, either living
or preserved by the best methods:—

Sycon; Clava, Obelia, Sertularia; Actinia, Tealia, Caryophyllia, Alcy-
onium; Hornimphora (preserved); Leptoplana; Lineus, Amphiporus; Nereis,
Aphrodite, Arenicola, Lanice, Terebella; Lepas, Balanus, Gammarus,
Ligia Mysis, Nebalia, Carcinus; Patella, Buccinum, Eledone, Pecten
Bugula, Crisia, Pedicellina, Holothuria, Asterias, Echinus; Ascidia, Salpa
(preserved), Scyllium, Raja, &c., &c.

For prices and more detailed lists apply to
Biological Laboratory, Plymouth.

THE DIRECTOR.

MINERALS, ROCKS & FOSSILS.
COLLECTIONS FOR STUDENTS.

Carefully labelled and arranged in Boxes with Card Trays.
50 Minerals, 12/6; 100 do., 21/-; 200 do., 42/-.

Rocks and Fossils at similar prices.

300 Minerals in Cabinet, £4 4s.; 400 do., £5 12s. 6d.

Catalogues Post Free.

THOMAS D. RUSSELL,

78 NEWGATE STREET, LONDON, E.C.

MINERALS, ROCKS, AND PRECIOUS STONES.

Choice Minerals for Museums, Characteristic Examples for the Teacher,
Student, or Prospector.

LAPIDARIES' WORK IN ALL BRANCHES.

BLOWPIPE CASES AND APPARATUS.
LESSONS GIVEN.

SAMUEL HENSON,

97 REGENT STREET, LONDON, W.

ESTABLISHED 1840.

CAMBRIDGE UNIVERSITY PRESS.

SCIENTIFIC PAPERS. By John William

STRUTT, BARON RAYLEIGH, D.Sc., F.R.S., Honorary Fellow
of Trinity College, Cambridge, Professor of Natural Philosophy in the
Royal Institution. To be completed in (probably) 4 volumes. Vol. I.,
1869-1881, nearly ready, 15s. net.

Now Ready. Demy 8vo, 12s.

THE STRENGTH OF MATERIALS.

By J. A. EWING, M.A., F.R.S., Professor of Mechanism and
Applied Mechanics in the University of Cambridge.

By the same Author.

THE STEAM ENGINE AND OTHER

HEAT ENGINES. Demy 8vo. With Illustrations. Second Edition.
Revised and Enlarged. 15s.

"To the thoughtful student of engineering science the book is in-
valuable."—*Nature*.

"Probably no other book on the steam engine has had compressed be-
tween its two covers so much sound information in so readable a form. It
should be in every student's hands."—*Electrician Review*.

THE TEACHING OF GEOGRAPHY IN

SWITZERLAND AND NORTH ITALY. Being the Report pre-
sented to the Court of the University of Wales on a visit to Switzerland
and North Italy in 1898, as Gilchrist Travelling Student. By JOAN
BERENICE REYNOLDS, B.A., Assistant-Mistress in the Cardiff
Intermediate School for Girls. 2s. 6d.

"It is replete with valuable suggestions, and no teacher of geography
can peruse its pages without being refreshed and immensely profited
thereby."—*Practical Teacher*.

CAMBRIDGE NATURAL SCIENCE MANUALS.

Geological Series. New Volume.

CRYSTALLOGRAPHY.

By W. J. LEWIS, M.A., Professor of Mineralogy in the University
of Cambridge. Demy 8vo, 14s. net.

London: C. J. CLAY & SONS, Cambridge University Press Warehou e
Ave Maria Lane.

Now Ready, large post 8vo, cloth, 6s.

THE

EVOLUTION OF GEOGRAPHY.

A Sketch of the Rise and Progress of Geographical
Knowledge, from the Earliest Times to the First
Circumnavigation of the Globe.

By JOHN KEANE.

WITH 19 MAPS, AND SEVERAL ILLUSTRATIONS.

London: EDWARD STANFORD, 26 and 27 Cockspur
Street, S.W.,

Geographer to the Queen.

JUST PUBLISHED. 8vo. Price 15s. net.

THE

KINETIC THEORY OF GASES.

ELEMENTARY TREATISE WITH MATHEMATICAL
APPENDICES.

By DR. OSKAR EMIL MEYER,

Professor of Physics at the University of Breslau.

Translated from the Second Revised Edition by

ROBERT E. BAYNES, M.A.,

Student of Christ Church, Oxford, and Dr. Lee's Reader in Physics.

LONDON: LONGMANS, GREEN, & CO.

ALBERT EDWARD JAMRACH

(Late CHARLES JAMRACH),

NATURALIST,

180 ST. GEORGE STREET EAST.

Implements of Savage Warfare, Idols, Sacred Masks, Peruvian Pottery
Netsukis China, Lacquers, Gongs, Shells, and other Curios.



CARL ZEISS, OPTICAL WORKS, JENA.

London Branch:
29 MARGARET STREET, REGENT
STREET, W.

MICROSCOPES and ACCESSORIES
—For Bacteriology, Biology, Mineralogy and Student's use. — Apochromatic, Achromatic Objectives. — Micrometers, &c.

OPTICAL MEASURING INSTRUMENTS.—Spherometers, New Crystal Refractometer, Butter-Refractometer for the rapid determination of the purity of Butter, Lard, an Glycerine.

NOTE.—We do not make Theodolites.

Illustrated Catalogues, including new edition (1898) of Catalogue of Microscopes, free. Please state which required.

PHYSICAL AND MECHANICAL APPARATUS.

EVERETT & CO.,

Engineers and Electricians,

22 CHARTERHOUSE SQUARE, LONDON, E.C.

Scientific and Electrical Instrument Makers.

Apparatus for Laboratories, &c., designed and made to meet any requirements.

MACHINES FOR ANY SPECIAL PURPOSE BUILT TO ORDER
MODELS DESIGNED AND MADE FOR INVENTORS.

*Accuracy combined with Highest Skill at Reasonable Charges.
REPAIRS OF EVERY DESCRIPTION.*

PATENTS.

JAMES G. LORRAIN, M.I.E.E., M.I.MECH.E., &c.,

CHARTERED PATENT AGENT,

Norfolk House, Norfolk Street, LONDON, W.C.

Speciality—**PHYSICAL PATENTS,**
OPPOSITIONS, AND AMENDMENTS.

Charges on Application.

Telephone No. 2511 GERRARD. Telegrams: "LORRAIN, LONDON."
"Patentees' Handbook" Post free on application.

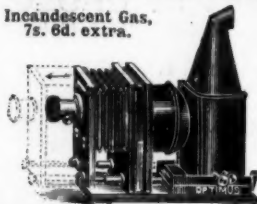
BORD'S PIANOS BECHSTEIN PIANOS

25 per cent. Discount for Cash, or 14/6 per month (second-hand, 10/6 per month) on the Three Years' System. Lists free of
C. STILES & CO., 40 & 42 Southampton Row, London, W.C.
PIANOS EXCHANGED.

These magnificent Pianos for Hire on the Three Years' System at advantageous prices and terms. Lists and particulars free of
CHAS. STILES & CO., 40 & 42 Southampton Row, LONDON, W.C.

"OPTIMUS" CANTILEVER PHOTOGRAPHIC ENLARGER.

Incandescent Gas,
7s. 6d. extra.



This already popular model is fitted in a very superior and practical style. The lamp gives a brilliant and even light. The optical system is throughout the best. The Lens will be found to give a very flat field and good marginal definition.

* SUITED FOR POCKET
CAMERA NEGATIVES.

Diam. of Condenser ...	* 4in.	5in.	6in.	8in.	10in.
Price, no Front Lens ...	62/-	70/-	80/-	110/-	200/-
Extra for Front Lens ...	27/-	27/-	37/-	63/-	63/-
Covering Plates ...	3 1/2 x 3 1/2	4 1/2 x 3 1/2	6 1/2 x 4 1/2	8 1/2 x 5 1/2	10 1/2 x 8 1/2

Catalogue POST FREE.

PERKEN, SON & RAYMENT, 99 HATTON GARDEN, HOLBORN CIRCUS, E.C. **LONDON.**

W. G. PYE & CO. Physical & Physiological Instrument Makers, 30 ST. ANDREW'S STREET, CAMBRIDGE.

STUDENTS' BRIDGE

Aggregate
Guaranteed
Platinoid



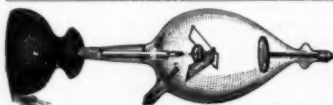
WHEATSTONE BOX.

12,220 ohms
to 1 in 500.
Wire.

Price £9 10s., as illustrated. Smaller Boxes, from £3.
IMPROVED REFLECTING GALVANOMETER,
for use with above, any resistance to 2000 ohms, £3.
Galvanometer Shunts, Galvanometer Lamps and Scales,
Keys, Single Coils, Batteries, &c.

Reliable Apparatus at low prices for teaching Mechanics, Hydrostatics, Heat, Optics, Magnetism and Electricity, as supplied to many of the leading Technical Institutes and Organised Science Schools.

Physical and Physiological List—Sixpence, Post free.



GLASS BLOWING

GEISSLER TUBES IN BEAUTIFUL DESIGNS.

TUBES containing specimens of Fluorescent and Phosphorescent Minerals, Salts, Rubies, &c.

ILLUSTRATED TUBE contains Vanes which Fluoresce in three brilliant colours, and revolve by means of Cathode Rays.

COSSOR, 67 FARRINGTON ROAD, E.C.

SECOND-HAND MICROSCOPES

By SWIFT, WATSON, CROUCH, BECK, ZEISS, LEITZ, &c.
Prices from £2 10s. to £45.

A Large Selection of Second-hand Powers and Fittings for all kinds of Microscopes.

Send for New List.

CLARKSON & CO., 28 Bartlett's Buildings, Holborn Circus, E.C.

"OPTIMUS" MAGIC LANTERNS FOR DRAWING ROOM AND LECTURE HALL.

Each Lantern is efficient for Exhibitions. The Lens gives crisp definition, being a superior Achromatic Photographic Combination, with Rack and Pinion, compound Condenser of 4in. diameter. Each has 3-wick Refulgent Lamp, and is Complete in box. (4-wick Lamp, 2s. extra.)



Mahogany outside Body, Panelled Door, Brass Stages, and 3-draw Sliding Tubes, so that lenses of long focus may be used when projecting upon a screen at a great distance, £5 5s.

Mahogany outside Body, lined with metal, making a thoroughly practical instrument, and really good value ... £2 12 0

Russian Iron Body, Brass Sliding Tubes (Educational)... 3 3 0

Do. do. (College) ... 2 8 0

Apparatus or estimation of sulphur in spent oxide.



FREDK. JACKSON & CO.

(Late MOTTERSHED & CO.),
14 CROSS STREET, MANCHESTER.

Goods Entrance: 10 Half-Moon Street,

LABORATORY FURNISHERS,
Importers, Manufacturers, and Dealers in
**CHEMICAL AND PHYSICAL
APPARATUS**

Of every Description.

Fine Chemicals, Volumetric Solutions,
Plain and Stoppered Bottles,

AND EVERY LABORATORY REQUIREMENT.

Illustrated Catalogue of Apparatus, with Price List
of Chemicals, free on application.

Telegraphic Address—"APPARATUS, MANCHESTER."
Telephone Number—2038.

MOORE'S HYDROSTATIC BALANCE

FOR ILLUSTRATING THE "PRINCIPLE OF
ARCHIMEDES" AND SPECIFIC GRAVITY.

A is a delicate spring balance accurately graduated to
read Grams, and is capable of being lowered or raised
by the string shown.

B is one of the set of cubes of various metals supplied
with the apparatus.

C is a glass vessel with fixed mark etched in glass, up
to which water, or other liquid, is placed. The
vessel is provided with draw-off cock.

Sole Makers of this Apparatus—

BREWSTER, SMITH, & CO.,
6 CROSS STREET, FINCHURCH, E.C.

Manufacturers and Importers of Chemical and Scientific
Apparatus and Pure Chemicals.

WEIGHTS a Speciality, 500 Milligrams to
1 Milligram, 1s. 6d. per doz.

SEND FOR COMPLETE ILLUSTRATED
CATALOGUE.



T. TAMBLYN-WATTS, SCIENTIFIC APPARATUS MAKER.

Catalogue of Electrical Apparatus and Materials, 6d. Post free.
Catalogue of Balances and Weights, Apparatus for the Study
of Mechanics, &c., 6d. Post free.

GOLDIELANDS, SETTLE, YORKS.

OPTICAL & SCIENTIFIC INSTRUMENTS.

Spectrometers, Spectroscopes, Goniometers, Cathetometers, Optical
Benches, &c., &c. Instruments for special purposes constructed to Clients'
own designs. Price List on application.

W. WILSON (formerly Foreman at Messrs. ELLIOTT BROS.),
1 Belmont Street, Chalk Farm Road, London, N.W.

CONTRACTOR TO H.M. GOVERNMENT.

WATKINS & DONCASTER,

NATURALISTS,

AND MANUFACTURERS OF

CABINETS AND APPARATUS

FOR ENTOMOLOGY, BIRDS' EGGS, AND ALL BRANCHES OF
NATURAL HISTORY.

SPECIAL SHOW-ROOM FOR CABINETS.

Call or send for detailed Catalogue (66 pp.), Post free on
application.

N.B.—For Excellence and Superiority of Cabinets and
Apparatus, references are permitted to distinguished
patrons, Museums, Colleges, &c.

A LARGE STOCK OF INSECTS AND BIRDS' EGGS.

Birds, Mammals, &c., Preserved and Mounted by First-class Workmen
with true natural surroundings. All Books and Publications on Natural
History supplied.

36 STRAND, LONDON. W.C.

(Five Doors from Charing Cross.)

PHYSIOGRAPHY and GEOLOGY.

COLLECTIONS & MICROSCOPIC SLIDES,

As advised by Science and Art Directory, arranged by

JAMES R. GREGORY & CO.,

Mineralogists, &c.,

To Science and Art Department, British, Indian and Colonial
Museums, &c.

**NOVELTIES and RARE GEMS and PRECIOUS
STONES.**

Mineral Specimens for Museums, and Collectors, and all purposes.

Rock Specimens and Microscopic Sections of Rocks and Minerals
cut to order.

**NEW and VALUABLE MINERAL SPECIMENS CONSTANTLY
ARRIVING.**

Stores & Offices: **1 Kelsao Place, KENSINGTON, W.**
NEW CATALOGUES AND LISTS FREE.

THORP'S FILM REPLICAS OF ROWLAND'S DIFFRACTION GRATINGS

(14,500 lines per inch), mounted

(1) On plate glass or parallel worked glass and prisms for ordinary
spectroscopic and projection work; (2) for small stellar and solar spectro-
scopes; (3) in pocket spectroscopes for rainband observations and chemical
analysis—splitting D distinctly.

3½" long or 5½" long Direct Vision Pocket Spectroscope, with
adjustable slit, spectrum over 20°, in Brass Case, price ... £3 0 0

(4) Mounted on hand telescopes or binoculars (adapted to customers' own
instruments) for eclipse work.

These Films bear considerable magnification excellently; and are suitable
for much work for which Rowland's Reflecting Gratings have hitherto been
used.

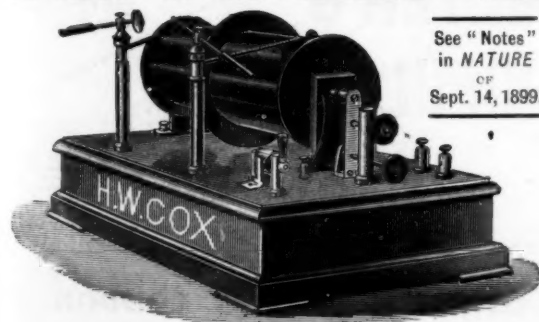
Instruments for special purposes designed and executed on the
shortest notice; or made from supplied designs.

ADAM HILGER,

204 STANHOPE STREET, N.W.

Telegraphic Address—"SPHERICITY, LONDON."

X-RAY & ÆTHERIC TELEGRAPHY APPARATUS



See "Notes"
in NATURE

OF
Sept. 14, 1899.

OF THE HIGHEST QUALITY AND FINISH ONLY.

As supplied by us to H.M. Government and the leading
Hospitals and X-Ray Workers throughout the World.

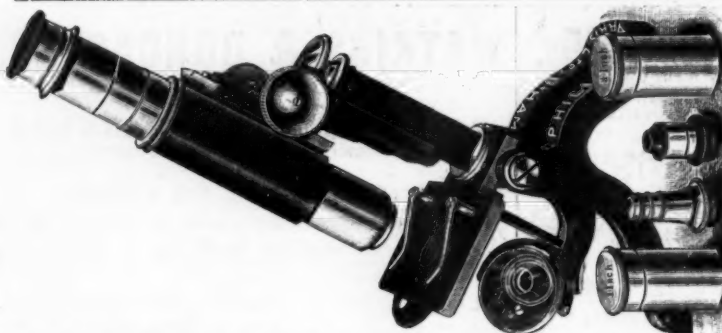
We are the actual Manufacturers, and Guarantee
every Coil against breaking down.

CALL OR WRITE FOR OUR NEW ILLUSTRATED LIST, WITH
TESTIMONIALS AND ILLUSTRATED INSTRUCTIONS UPON HOW
TO WORK. POST FREE TO READERS OF "NATURE."

HARRY W. COX, Ltd.,

10, 11, 28 CURSITOR STREET,
CHANCERY LANE, LONDON.

Radiographs taken for Scientific and Medical Men, and
Demonstrations given.



THE "HARRIS" MICROSCOPE.

With Rackwork, £4 5 0
Without " £3 12 6

This is a first-class Microscope at a moderate price; it has fine adjustment of best design. Base is solid and rigid, and is designed for comfort in use. Complete with 2 Mirrors, Rotating Diaphragm, Eye-piece, 2 Achromatic Object Glasses, $\frac{1}{4}$ " giving 140 to 280 diameters and $1\frac{1}{2}$ " giving 40 to 85 diameters. Draw Tube, Standard Screws.

The whole packed in Polished Mahogany Case.

If with $\frac{1}{4}$ " instead of $1\frac{1}{2}$ ", £3 17s. 6d.
Giving 170 to 340 diameters.

PHILIP HARRIS & CO., LTD., Chemical & Physical Apparatus Makers, BIRMINGHAM.

WATSON'S NEW MICROSCOPES AND APPARATUS.



WATSON'S HOLOSCOPIC EYEPIECES, for use with either APOCHROMATIC or ACHROMATIC OBJECTIVES, an adjustment being provided to the special lenses employed, for altering the correction. There is no sacrifice of efficiency, the performance being equal to the most expensive Compensating or Huyghenian Oculars.

Magnifying Powers—

6 in. tube length, 5, 7, 10, and 14 diameters.
10 in. " 7, 10, 14, and 20 "

PRICE, in Student's Size and Pattern, either power, 17/6 each.

For Full Particulars see Supplemental List, Post Free.

W. WATSON & SONS (Established 1837). Opticians to H.M. Government.

313 HIGH HOLBORN, LONDON, W.C. New Branch Now Open: 16 FORREST ROAD, EDINBURGH. And at 78 Swanston Street, Melbourne, Australia. Awarded 30 Gold and other Medals at the principal International Exhibitions of the World.

WATSON'S PARACHROMATIC OIL IMMERSION CONDENSER.

Total aperture, $1\frac{1}{30}$; planatic aperture exceeds $1\frac{1}{2}$ s. Undoubtedly the finest Condenser obtainable for high-power work. Optical part only ... £5 0 0

Completely mounted with Iris Diaphragm and Set of Stops ... £6 10 0

WATSON'S "SCHOOL" MICROSCOPE, New Model, complete with 7 in. Objective, in Case ... £3 3 0

WATSON'S "ROYAL" MICROSCOPE. A new model high-class instrument.

WATSON'S "FRAM" MICROSCOPE. A highest-class instrument at a very moderate cost.

BACTERIOLOGICAL APPARATUS. MICROTOMES. Apparatus for FIELD BOTANY and FIELD GEOLOGY. METAMORPHOSES and DISSECTED PREPARATIONS. BOTANICAL and PHYSIOLOGICAL MODELS.

For Particulars of all the above, see

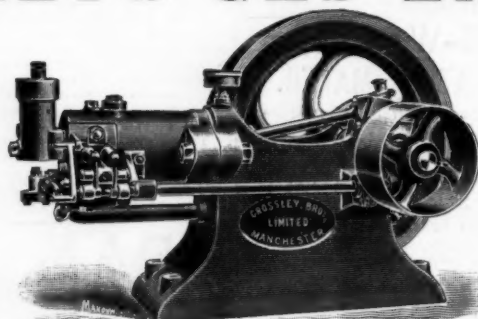
Watson's New Supplemental List to Catalogue No. 2, Post Free on application.

Watson's Catalogue (No. 3) is a Classified List representing a Stock of 40,000 first-class Micro-Slides, Post free on application.

CROSSLEY'S GAS ENGINES.

RECENTLY

REMODELLED.



GREAT
REDUCTION
IN
GAS
CONSUMED.

CROSSLEY BROS., LTD., OPENSHAW, MANCHESTER.



DALLMEYER'S POPULAR

PRICE
£7 7s.

HAND CAMERA.

Twelve $\frac{1}{4}$ -plates in sheaths, instantaneous changing, rack focussing, ever-set shutter with speed regulator, mahogany body covered good leather, and fitted with a **STIGMATIC LENS**, working at $f. 7\frac{1}{2}$.

Send for fully Illustrated List of Lenses and Cameras.

J. H. DALLMEYER, Ltd., 25 Newman St., LONDON, W.

Printed by RICHARD CLAY AND SONS, LIMITED, at 7 & 8 Bread Street Hill, Queen Victoria Street, in the City of London and published by MACMILLAN AND CO., LIMITED, at St. Martin's Street, London, W.C., and THE MACMILLAN COMPANY, 66 Fifth Avenue, New York.—THURSDAY, Nov. 16, 1899.

GENERAL LIBRARY,
UNIV. OF MICH.
DEC 6 1899



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

No. 1569, VOL. 61]

THURSDAY, NOVEMBER 23, 1899.

[PRICE SIXPENCE.

Registered as a Newspaper at the General Post Office.]

[All Rights are Reserved.

THE TRANSVAAL AND THE WAR.

NEW LANTERN SLIDES. Plain Slides, 12. each.

- | | |
|------------------------------------|------------------------------------|
| 1 Map of South Africa. | 26 Camping out before Nachtmal. |
| 2 Bloemfontein: General View. | 27 Mafeking Stage Coach. |
| 3 Market Square. | 28 Transvaal Gold Diggings. |
| 4 Cattle Farm near Newcastle. | 29 Bronk-horst Spruit. |
| 5 Group of Kaffirs and Kraal. | 30 Portrait of President Kruger. |
| 6 Crossing a Drift in Ox Waggon. | 31 President Kruger's House. |
| 7 Boer Family. | 32 Major Wilson's Last Stand. |
| 8 Delagoa Bay. | 33 Floreat Etona at Laing's Nek. |
| 9 Durban: Landing Stage. | 34 Burial Ground at Laing's Nek. |
| 10 Durban: Town Hall. | 35 Summit of Majuba Hill. |
| 11 West Street. | 36 Majuba Graves. |
| 12 Johannesburg: The Reef. | 37 Elandsfontein Junction. |
| 13 The Main Reef. | 38 Jameson's Raid: the Last Stand. |
| 14 The Hospital. | 39 Sir George White, V.C. |
| 15 The Market. | 40 Sir Redvers Buller, V.C. |
| 16 Kimberley: View of the Rail. | 41 President Kruger at Home. |
| 17 Market Square. | 42 Boers. Outspan on the Trek.— |
| 18 Diamond Mine. | Examining the New Rifles. |
| 19 De Beers Mine. | 43 Boer Commando leaving by Rail. |
| 20 Compound. | 44 Field Cornet delivering Orders. |
| 21 Searching Nigger | 45 In the Drakensburg Range. |
| for Diamonds. | 46 Colonel Baden Powell. |
| 22 Barberton. | 47 Ladysmith: General View. |
| 23 Natal Harbour. | 48 Boer Commando on March. |
| 24 Port Elizabeth, Main Street. | 49 Charlestown Tunnel and Train. |
| 25 Pretoria: Government Buildings. | 50 Map of the Seat of War. |

This List will be added to.

Full detailed List of Lanterns and Slides on application, Six Stamps.

NEWTON & CO., 3 FLEET STREET, E.C.

A NEW DEPARTURE in CHEMICAL BALANCES



BALANCE on Polished Mahogany Base, Three Levelling Screws, &c., Plummet for levelling. Adjusting Screws for counterpoising Beam. Steel Knife Edges. Will carry 100 grms. in each pan and turn with 1-2 m.g. 24/-

BALANCE as above, with Agate Edges bound in Brass. Will carry 100 grms. and turn with 0.5 m.g. 29/6.

JOHN J. GRIFFIN & SONS, L.D.,
20-26 SARDINIA STREET, LONDON, W.C.

SELECTED FROM

MR. MURRAY'S UNIVERSITY EXTENSION MANUALS.

Edited by Prof. KNIGHT, of St. Andrews University.

THE STUDY OF ANIMAL LIFE. By J. ARTHUR THOMSON, Regius Professor of Natural History in the University of Aberdeen. With many Illustrations. 5s.

THE REALM OF NATURE: A Manual of PHYSIOGRAPHY. By Dr. HUGH ROBERT MILL, Librarian to the Royal Geographical Society. With Nineteen Coloured Maps and Sixty-eight Illustrations. 5s.

AN INTRODUCTION TO MODERN GEOLOGY. By R. D. ROBERTS. With Coloured Maps and Illustrations. 5s.

THE PHYSIOLOGY OF THE SENSES. By JOHN M'KENDRICK, Professor of Physiology in the University of Glasgow; and Dr. SNODGRASS, Physiological Laboratory, Glasgow. 4s. 6d.

THE ELEMENTS OF ETHICS. By JOHN H. MUIRHEAD, Balliol College, Oxford, Lecturer on Moral Science Royal Holloway College; Examiner in Philosophy to the University of Glasgow. 3s.

LOGIC, INDUCTIVE AND DEDUCTIVE. By WILLIAM MINTO, late Professor of Logic and Literature, University of Aberdeen. 4s. 6d.

* A Complete List of the above Series can be had Post free on application. JOHN MURRAY, ALBEMARLE STREET, W.

CHRISTMAS PRESENTS. NEGRETTI & ZAMBRA'S

SELF-RECORDING

METEOROLOGICAL INSTRUMENTS.

THE THERMOGRAPH, for Outdoor or Indoor Observation.



This Instrument is mounted in a Japanned Metal Case with Glass Front, and gives continuous records on Charts which only require changing once a week, and is invaluable to invalids and others who are unable to take daily readings of the ordinary instruments.

Price, with supply of Charts for one year, £7 0 0.

Accurate Thermometers for all purposes.

"Special" Illustrated Price List of Instruments, suitable for Presents, free by post.

NEGRETTE & ZAMBRA,
38 HOLBORN VIADUCT, E.C.

BRANCHES: 45 CORNHILL, and 122 REGENT STREET, London.

CHRISTMAS LECTURES. ROYAL INSTITUTION OF GREAT BRITAIN.

ALBEMARLE STREET, PICCADILLY, W.

CHARLES VERNON BOYS, Esq., F.R.S., will deliver a Course of Six Lectures (adapted to a Juvenile Auditory) on "Fluids in Motion and at Rest," Experimentally Illustrated, commencing on Thursday, December 28, 1899, at 3 o'clock; to be continued on December 30, 1899, and January 2, 4, 6, 9, 1900. Subscription for Non-Members to this Course, One Guinea (Children under 16, Half-a-Guinea); to all the Courses in the Season, Two Guineas. Tickets may now be obtained at the Institution.

HEATHCOTE SCIENCE LABORATORIES.

These Laboratories are open for RESEARCH work, at any hours or times most convenient for worker, in Chemistry, General Physics and Bacteriology. Commercial processes can be worked out in Chemistry and Electricity, and powerful Currents, Constant or Alternating, can be used. Eight feet of Bench fitted with Sink and Cupboard, Electricity, Gas, Water and Exhaust, £3 3s. for one month. Private Laboratory, with same fittings, £4 14s. 6d. for one month. The above includes use of all ordinary Glass and other Apparatus and use of Accurate Balances, and other Standard General Instruments, also Furnaces, &c.

For further particulars apply, THE DIRECTOR, Heathcote Science Laboratories, 9 Heathcote Street, Gray's Inn Road, W.C.

Telegrams—"Tunzelmann, London."

THE ELECTRICAL AND GENERAL ENGINEERING COLLEGE.

PRESIDENT—G. W. DE TUNZELMANN, B.Sc. Lond., M.I.E.E.

PRINCIPAL—J. H. REEVES, M.A. Cantab.

Next SESSION begins WEDNESDAY, SEPTEMBER 27.

Particulars on application to the SECRETARY, 2 and 4 Pennywelf Road, Earl's Court, S.W.

B.A. AND B.Sc. MATRICULATION, INTERMEDIATE, FINAL.

PREPARATION BY CORRESPONDENCE AND ORAL TUITION on a THOROUGHLY INDIVIDUAL SYSTEM. Fees based on success. The STAFF includes Graduates of Oxford, Cambridge, London, and Royal Universities, Science Medallists, Prizemen, Scholars, &c.

SINGLE SUBJECTS TAKEN: Latin, Greek, French, German, Mathematics, Science, Logic, Psychology, Political Economy, &c.

For Terms, &c., address Mr. J. CHARLESTON B.A. (Lond. and Oxon.), The Burlington Classes, 27 Chancery Lane, London, W.C.

B.A., PRELIMINARY SCIENTIFIC, B.Sc., and all other EXAMS.

QUERNMORE.

London Branches—(1) 24 CHANCERY LANE, W.C.; (2) 115 EBURY STREET, EATON SQUARE, S.W.

Special Preparation by JOHN GIBSON, M.A. (First Class, Cambridge), and G. LÖLY, B.A. (First Class, London), assisted by large Staff of Specialist Tutors. Practical Laboratories. Write for particulars to Messrs. GIBSON & LÖLY, 24 Chancery Lane, W.C.

SCIENCE EXAMINATIONS.

For LONDON and other UNIVERSITIES, the
CONJOINT BOARD, &c.

Well-equipped LABORATORIES, DAY AND EVENING. Personal or Class Tuition.

"R," 9 Heathcote Street, Gray's Inn Road, W.C.

EXPERIMENTAL WORKS, BATH.—

Facilities for conducting Scientific and Mechanical Investigations. Pupil taken. Seventy acres of ground.—Apply to MANAGER.

BOROUGH OF DERBY.

MUNICIPAL TECHNICAL COLLEGE.

The Committee invite applications for the Post of LECTURER IN MATHEMATICS AND PHYSICS for Day and Evening Classes.

Salary, £200 per Annum. Applications, on Forms which may be obtained from the Registrar, should be received not later than Thursday, November 30.

F. W. SHURLOCK, B.A., B.Sc. (Principal).

ELEMENTARY PHYSICS TEACHING.

—Wanted at once, at the WATFORD ENDOWED SCHOOL, a MASTER to teach PHYSICS two days in the week, Wednesdays and Thursdays. An A.R. Coll. Sc. preferred. A salary of £50 per annum and Railway Fares will be paid.—Apply to the HEADMASTER.

UNIVERSITY COLLEGE OF NORTH WALES.

(A CONSTITUENT COLLEGE OF THE UNIVERSITY OF WALES.)

Applications are invited for the CHAIR of PHYSICS now Vacant in this College. The Council will elect on December 20th. Forty copies of the Application and Testimonials to be in the hands of the undersigned not later than Monday, December 4th. The Professor will be expected to enter on his duties at the beginning of the New Year. For further particulars apply to

JOHN EDWARD LLOYD, M.A., Secretary and Registrar.

Bangor, November 8th, 1899.

THE DURHAM COLLEGE OF SCIENCE, NEWCASTLE-UPON-TYNE.

LECTURER IN AGRICULTURE.

The Council invite Applications for the Post of LECTURER in AGRICULTURE. Salary, £250 per Annum and a proportion of the Fees received for County Lectures.

Applications, with testimonials, should be sent not later than DECEMBER 2, 1899, to the undersigned, from whom further particulars may be obtained.

F. H. PRUEN, Secretary.

WANTED, at once, Private Assistant, un-

married, not 25, to manage small Electrical Installation, prepare Chemistry and Physics Lectures, and keep Laboratory premises in order.—Apply, with references, to T. C. PORTER, Eton, Windsor. Wages: £100 a year, when able to do full work.

BOTANIST (28), B.Sc. (Lond.), Ph.D.

(Goett.), seeks position as LECTURER or DEMONSTRATOR; or RESEARCH, preferably Veg. Physiology, incl. Bacteriology; or Literary Work (trans.); Knowledge of Chemistry.—"Z," NATURE Office.

FOR SALE.—A BARGAIN.

14-inch ASTRONOMICAL THEODOLITE, with Portable Stand, by TROUGHTON & SIMMS. Complete for any Astronomical or Terrestrial purposes. The Instrument has already done excellent work, is now in perfect order and adjustment, and almost equal to new. The Object Glass is a particularly good one. Original cost £220; would accept £80, as owner just retired from public service abroad.—Apply "B. J. O.," 8 Hatton Garden, E.C., where instrument can be seen.

PATENTS.

JAMES G. LORRAIN, M.I.E.E., M.I.MECH.E., &c.,
CHARTERED PATENT AGENT,

Norfolk House, Norfolk Street, LONDON, W.C.

Speciality—PHYSICAL PATENTS,
OPPOSITIONS, AND AMENDMENTS.

Charges on Application.

Telephone No. 2511 GERRARD. Telegrams: "LORRAIN, LONDON."
"Patentees' Handbook" Post free on application.

PHYSICAL AND MECHANICAL APPARATUS.

EVERETT & CO.,

Engineers and Electricians,

22 CHARTERHOUSE SQUARE, LONDON, E.C.

Scientific and Electrical Instrument Makers.

Apparatus for Laboratories, &c., designed and made to meet any requirements.

MACHINES FOR ANY SPECIAL PURPOSE BUILT TO ORDER.

MODELS DESIGNED AND MADE FOR INVENTORS.

Accuracy combined with Highest Skill at Reasonable Charges.
REPAIRS OF EVERY DESCRIPTION.

GLASS BLOWING.

All kinds of Experimental Glass
Blowing carried out for Scien-
tific Men, Laboratories, &c.

INVENTORS' IDEAS WORKED OUT AS PER
INSTRUCTIONS.

COSSOR,

67 Farringdon Road, E.C.



Shadow of
Cross Tube.

BARGAINS IN SCIENTIFIC BOOKS.

COOKE (M. C.), THE BRITISH FUNGI.
A PLAIN AND EASY ACCOUNT OF. With Coloured Plates of 40 Species. Revised Edition. Crown 8vo, Cloth (pub. 6s.), 2s. 6d.

"The new work on the fungi appears to be equally valuable with those which he has already printed. It contains descriptions of the esculent fungi, the manner in which they are prepared for the table, how to discriminate the nutritious from the poisonous species, details of the principles of their scientific classification, and a tabular arrangement of orders and genera."

MICROSCOPIC FUNGI: an Intro-

duction to the Study of Microscopic Fungi, Rust, Smut, Mildew, and Mould. Illustrated with 250 Coloured Figures by J. E. SOWERBY. Fifth Edition, Revised and Enlarged, with Appendix of New Species. Crown 8vo, Cloth (pub. 6s.), 2s. 6d.

"Those of our readers who are the happy possessors of microscopes would welcome this book with delight, as opening the way to a definite study of a most interesting branch of plant life. The minute fungi, here so faithfully depicted by Mr. Sowerby, and so carefully described by Dr. Cooke, have not only beauty of form and colour, but wonderful life histories."

HANDBOOK OF BRITISH HEPATICA.

containing Descriptions and Figures of the Indigenous Species of Marchantia, Juggermania, Riccia, and Anthoceros. Illustrated. Crown 8vo, Cloth (pub. 6s.), 2s. 6d.

"Probably no group in the British flora has received so little attention as the Hepaticae. Dr. M. C. Cooke has now filled up the gap by producing a 'Handbook of the British Hepaticae,' containing full descriptions of all the species, about two hundred in number, known to inhabit the British Islands."—NATURE.

OUR REPTILES AND BATRA-

CHIANS, a Plain and Easy Account of the Lizards, Snakes, Newts, Toads, Frogs, and Tortoises, indigenous to Great Britain. New and Revised Edition, with original Coloured Pictures of every Species, and numerous Woodcuts. Crown 8vo, Cloth (pub. 6s.), 2s. 6d.

CONTENTS.—Reptiles and Snake-stones, the Common Lizard, the Sand Lizard, the Green Lizard, the Natterjack, the Palmate Newt, the Leather Turtle, the Blind Worm, the Common Snake, the Smooth Snake, the Viper or Adder, Great Water Newt, Gray's Banded Newt, Amphibia or Batrachians, the Common Frog, the Edible Frog, the Common Toad, Common Smooth Newt or Kft, the Hawk's-Bill Turtle, Appendix.

Postage extra.

H. J. GLAISHER, New and Remainder Bookseller, 57 Wigmore Street, London, W.

Catalogues Post Free on application.

PHYSICS, EXPERIMENTAL & THEORETICAL.

By R. H. JUDE, M.A. (Cantab.), B.Sc. (Lond.).

Principal of the Physical Department, Rutherford College, Newcastle-on-Tyne.

And partly from the French of H. GOSSIN.

With numerous Illustrations, Examples, and Exercises. Vol. I. demy 8vo, Price 12s. 6d. net.

CONTAINING

Part I. INTRODUCTORY (MECHANICS, HYDROSTATICS, and PNEUMATICS).

Part II. HEAT. Part III. ACOUSTICS.

The Three Parts are also sold separately.

Part I., 3s. 6d. net; Part II., 7s. 6d. net; Part III., 2s. 6d. net.

OPINIONS OF THE PRESS.

"The increasing study of science in schools has been the cause of a considerable crop of text-books in Elementary Physics, but there is still the want of a more advanced book on the subject. This want Dr. R. H. Jude has endeavoured to supply, and . . . has succeeded in giving us what promises to be a very useful work both to teachers and students."—NATURE.

"A very comprehensive and complete treatise, advancing in each subject from carefully enunciated definitions of terms and expositions of principles to fairly advanced theorems and problems. . . . This new course of Physics deserves careful attention. . . . It combines many excellent features."—Educational Times.

"The original intention of merely translating Prof. Gossin's 'Cours de Physique' has been so far modified that Dr. Jude's additions form by far the greater part of the book. . . . Some of the theoretical sections which he has written are particularly well done, and his experience as a teacher has enabled him to do good service by adequately treating many points which are generally slurred over or misunderstood."—Guardian.

"It is plain from this book that Dr. Jude is a marvellously good teacher; his clear, vigorous explanations, his methods of approaching difficult points, his firm attack of those puzzles well known as causing haziness in the student's mind, are of unusual excellence; and even more so the exercises, with their continual reference to matters of daily life, giving the young science student a direct stimulus to keep his natural powers of observation and his acquired powers of analysis working constantly together. One does not often find a book so stimulating to thought in this particular direction."—Saturday Review.

"Dr. Jude has not been content merely to expound the common doctrine of Science, but in places has enriched the book by original researches. . . . Students of science have no lack of books to choose from, but treatises such as this, which combine the Englishman's practical knowledge, with the Frenchman's gift of lucid exposition for the needs of learners, are rare."—Scotsman.

CHAPMAN & HALL, LIMITED, London.

THE QUAKER BATH CABINET

Should be in Every Home for HOT-AIR, VAPOUR,
or MEDICATED BATHING PURPOSES.

Makes Clean, Healthy, Strong and Vigorous Men and Women.

NATURE'S COMPLEXION BEAUTIFIER.

Cures a Bad Cold with One Bath, Averts Fevers, La Grippe, &c.



Cures the most obstinate cases of Rheumatism, Obesity, Neuralgia, La Grippe, Malaria, Catarrh, Piles, Dropsy, all Blood, Skin, Kidney, and Nervous Troubles.

25s. each, post free,

Sent ready for immediate use.

RECOMMENDED BY THE
BEST PHYSICIANS.

Folds into 3 in. by 28 in. space; weighs 7 lbs.

These Health Baths should be taken by all persons, whether healthy or unhealthy, at least once or twice a week. They open the 5,000,000 sweat pores of the skin, and force out by Nature's method all the impure, poisonous matter which causes disease.

Soap and water simply cleanse the surface or outside of the body, while these Thermal Baths cleanse inwardly and outwardly, making the blood pure, sleep sound, skin soft, white and beautiful. They prevent disease.

Descriptive (Z) Pamphlet Post Free.

THE GEM SUPPLIES CO.,

6 BISHOP'S COURT, CHANCERY LANE, LONDON, W.C.

Cloth. Demy 8vo. Price 12s. Net.

AN INTRODUCTION TO THE STUDY OF THE

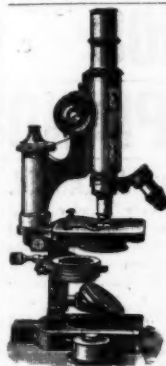
DIATOMACEÆ,

By FREDERICK WM. MILLS, F.R.M.S.

With a Bibliography by JULIAN DEBY, F.R.M.S.

CONTENTS.—Preliminary Remarks—The Structure of Diatoms—Movement of Diatoms—Classification of the Diatomaceae, with a Conspectus of the Families and Genera—Modes of Reproduction—Collecting Diatoms—Mounting Diatoms—Microscopical Examination—How to Photograph Diatoms—Bibliography—Index.

London: LILFE, SONS, & STURMEY, Ltd., 3 St. Bride Street, E.C.



CARL ZEISS,

OPTICAL WORKS, JENA.

London Branch:

59 MARGARET STREET, REGENT STREET, W.

MICROSCOPES and ACCESSORIES

—For Bacteriology, Biology, Mineralogy and Student's use.—Apochromatic, Achromatic Objectives.—Micrometers, &c.

OPTICAL MEASURING INSTRUMENTS.

—Spherometers, New Crystal Refractometer, Butter-Refractometer for the rapid determination of the purity of Butter, Lard, and Glycerine.

NOTE.—We do not make Theodolites.

Illustrated Catalogues, including new edition (1898) of Catalogue of Microscopes, free. Please state which required.

OPTICAL & SCIENTIFIC INSTRUMENTS.

Spectrometers, Spectroscopes, Goniometers, Cathetometers, Optical Benches, &c., &c. Instruments for special purposes constructed to Clients own designs. Price List on application.

W. WILSON (formerly Foreman at Messrs. ELLIOTT BROS.),
1 Belmont Street, Chalk Farm Road, London, N.W.

CONTRACTOR TO H.M. GOVERNMENT.

JAS. SWIFT & SON, MANUFACTURING OPTICIANS.



SOLELY APPOINTED TO THE A.M. DEPT.
WAR OFFICE, FOR THE SUPPLY
OF MICROSCOPES.

Patent form of Student's Microscope,
fitted with $\frac{2}{3}$ " and $\frac{1}{6}$ " Pan-Aplanatic
Objectives, Iris Diaphragm and Oculars,
in Case, from

£5 5s.

These Instruments we have supplied in
numbers to the following Medical Schools,
viz. St. Mary's, St. Bartholomew's, Guy's,
Middlesex, London, and St. Thomas's.

Seven Gold Medals awarded for excel-
lence of manufacture.

Catalogue on Application.

81 TOTTENHAM COURT ROAD, W.

SECOND-HAND MICROSCOPES.

POWELL & LEALAND, No. 1,

with Apparatus ... £50

POWELL & LEALAND, No. 2,

with Apparatus ... £50

BECK British Students, 2 Eye-

pieces, $\frac{3}{4}$ " & $\frac{1}{2}$ " ... £5 10s.

A large number of Second-hand

Objectives by the best makers.

SECOND-HAND TELESCOPES.

COOKE Equatorial, 4-inch £50

ALVAN CLARK, 8-inch £50

C. BAKER'S, 244 High Holborn, London.

ZEISS Stand, iv.a, with Abbe

condenser and triple nose-

piece ... £11 10s.

BAKER Model Microscope,

ZEISS A and D Objectives,

Nose-piece, &c., in Case £7

ROSS Binocular, with Appar-

atus, Portable Case ... £25

DALLMEYER, 8-inch £450

DALLMEYER, 3-inch, portable

equatorial stand ... £60

PHŒNIX FIRE OFFICE, 19 LOMBARD ST., E.C., and 57 CHARING CROSS, S.W.

ESTABLISHED 1782.

MODERATE RATES. ABSOLUTE SECURITY.

ELECTRIC LIGHTING RULES SUPPLIED.

LIBERAL LOSS SETTLEMENTS.

PROMPT PAYMENT OF CLAIMS.

FRANCIS B. MACDONALD, SECRETARY.

LOSSES PAID OVER £22,000,000

ALBERT EDWARD JAMRACH (Late CHARLES JAMRACH), NATURALIST,

180 ST. GEORGE STREET EAST.

Implements of Savage Warfare, Idols, Sacred Masks, Peruvian Pottery,
Netsukis China, Lacquers, Gongs, Shells, and other Curios.

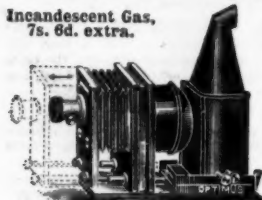
BORD'S PIANOS BECHSTEIN PIANOS

25 per cent. Discount for Cash, or 14/6 per month (second-hand, 10/6 per
month) on the Three Years' System. Lists free of
C. STILES & CO., 40 & 42 Southampton Row, London, W.C.
PIANOS EXCHANGED.

These magnificent Pianos for Hire on the Three Years' System at
advantageous prices and terms. Lists and particulars free of
CHAS. STILES & CO., 40 & 42 Southampton Row,
LONDON, W.C.

"OPTIMUS" CANTILEVER PHOTOGRAPHIC ENLARGER.

Incandescent Gas,
7s. 6d. extra.



This already popular model
is finished in a very superior
and practical style. The lamp
gives a brilliant and even light.
The optical system is through-
out the best. The Lens will
be found to give a very flat
field and good marginal defini-
tion.

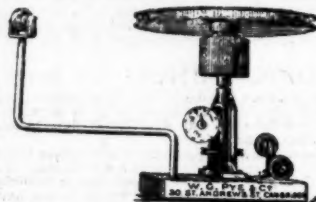
* SUITED FOR POCKET
CAMERA NEGATIVES.

Diam. of Condenser	4in.	5in.	6in.	8in.	10in.
Price, no Front Lens	62/-	70/-	82/-	110/-	200/-
Extra for Front Lens	27/-	27/-	37/-	63/-	63/-
Covering Plates	34x34	44x34	64x44	84x54	104x54

Catalogue POST FREE.

PERKEN, SON & RAYMENT, 99 HATTON GARDEN, HOLBORN CIRCUIS, E.C. LONDON.

W. G. PYE & CO. Physical & Physiological Instrument Makers, 30 ST. ANDREW'S STREET, CAMBRIDGE.



Apparatus
for Determining
the
Mechanical Equivalent
of Heat.

PRICE
£4 10s.

Specialities for teaching Experimental Physics. Good quality, moderate
prices. Resistance Boxes, Single Coils, KEYS, Galvanometers, Bridges
Batteries, etc.

Physical and Physiological Lists—Sixpence, Post free.

TO SCIENCE LECTURERS. HUGHES' MOTO-PHOSCOPE FOR LIVING PICTURES. THE MOST PERFECT.

No SHUTTER, therefore no Flickering. Superb Mechanism.
The Moto-Photo Camera for taking the Pictures. Illustrated Lists, 2d.
See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN,
&c. Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great
success. New Oxyhydrogen Microscope. Science Lanterns for Class
Demonstration. Magnificent Results. Docwra Triple, Prize Medal,
Highest Award. Supplied to the Royal Polytechnic Institution, Dr. H. GRAT-
TAN GUINNESS, Madame ADELINA PATTI, &c., &c. Patent Pampengos
Science Lanterns. The Universal Lantern 4-inch Condensers, 4-wick Lamp,
Portrait Combination front Lenses, 18s. 6d., Marvellous value. Science
Lecture Sets. Novelties. The Lantern Kaleidoscope. Cheapest Lantern
Outputs in the World. Grandly Illustrated Catalogue, over 180 choice En-
gravings, 6d.; Postage, 3d. List of 300 Lecture Sets, Science Subjects,
Views, &c., 6d.; Postage 2d. Pamphlets Free. W. C. HUGHES,
SPECIALIST, Brewster House, 8s Mortimer Road, Kingsland, N.

ESTABLISHED 1851.

BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

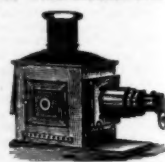
INVESTED FUNDS

£10,000,000.

The BIRKBECK ALMANACK, with full particulars, post free.
FRANCIS RAVENSCROFT, Manager.

"OPTIMUS" MAGIC LANTERNS FOR DRAWING ROOM AND LECTURE HALL

Each Lantern is efficient for Exhibitions.
The Lens gives crisp definition, being a
superior Achromatic Photographic Combi-
nation, with Rack and Pinion, compound Con-
denser of 4in. diameter. Each has 3-wick
Refrilgent Lamp, and is Complete in box.
(4-wick Lamp, 2s. extra.)



Mahogany outside Body, Panelled Door,
Brass Stages, and 3-draw Sliding Tubes, so
that lenses of long focus may be used when
projecting upon a screen at a great distance, £5 5s.

Mahogany outside Body, lined with metal, making a
thoroughly practical instrument, and really good value ... £2 12 0

Russian Iron Body, Brass Sliding Tubes (Educational)... 3 3 0

Do. do. (College) ... 2 8 0

99 HATTON GARDEN, HOLBORN CIRCUIS, E.C. LONDON.

NATURE RE-ISSUE OF SOWERBY'S ENGLISH BOTANY.

THIRD EDITION: WITH SUPPLEMENT.

THIRTEEN VOLUMES.

CONTAINING a DESCRIPTION and a HAND-COLOURED LIFE-SIZE DRAWING OF EVERY BRITISH PLANT.

PUBLISHERS' PRICES.

Cloth Binding	£25 0 0
Half-Morocco	£27 10 0

BY INSTALMENT. (TO-DAY.)

Cloth Binding	£16 16 0
Half-Morocco	£19 19 0

FOR CASH. (TO-DAY.)

Cloth Binding	£16 0 0
Half-Morocco	£19 0 0

SOWERBY'S ENGLISH BOTANY.

For over 100 years A STANDARD AUTHORITY.

- (1) Is illustrated by nearly two thousand beautiful hand-coloured Plates.
- (2) Contains a technical description of each plant, with a popular sketch by Mrs. LANKESTER.
- (3) Is completed by an Index of over one hundred pages, with (a) Botanical names, (b) common English names, (c) Synonyms, (d) French and German equivalents.

Copies of the Book may be seen at NATURE Office, St. Martin's Street, W.C. An explanatory pamphlet, giving specimen pages, full contents, extracts from the preface, with a sample illustration and order form, will be sent Post free on application to

C. WORSFOLD, NATURE Office,
St. Martin's Street, London, W.C.

CONTENTS.

VOL. I.—All the Plants ranked under the orders Ranunculaceæ, Berberidaceæ, Nymphaeaceæ, Papaveraceæ, and Crucifereæ.

VOL. II.—All the Plants ranked under the orders Resselaceæ, Cistaceæ, Violaceæ, Droseraceæ, Polygalaceæ, Frankeniaceæ, Carophyllaceæ, Portulacaceæ, Tamariscaceæ, Elatinaceæ, Hypericaceæ, Malvaceæ, Tiliaceæ, Linaceæ, Geraniaceæ, Illiciaceæ, Celastraceæ, Rhamnaceæ, Sapindaceæ.

VOL. III.—All the Plants ranked under the orders Leguminifereæ and Rosaceæ.

VOL. IV.—All the Plants ranked under the orders Lythraceæ, Onagraceæ, Cucurbitaceæ, Grossulariaceæ, Crassulaceæ, Saxifragaceæ, Umbellifereæ, Araliaceæ, Cornaceæ, Lorantheaceæ, Caprifoliaceæ, Rubiaceæ, Valerianaceæ, and Dipsaceæ.

VOL. V.—All the Plants ranked under the order Compositæ.

VOL. VI.—All the Plants ranked under the orders Campanulaceæ, Ericaceæ, Jasminaceæ, Apocynaceæ, Gentianaceæ, Polemoniaceæ, Convolvulaceæ, Solanaceæ, Scrophulariaceæ, Orobanchaceæ, and Verbenaceæ.

VOL. VII.—All the Plants ranked under the orders Labiataæ, Boraginaceæ, Lentibulariaceæ, Primulaceæ, Plumbaginaceæ, Plantaginaceæ, Paronychiaceæ, and Amarantaceæ.

VOL. VIII.—All the Plants ranked under the orders Chenopodiaceæ, Polygonaceæ, Eleanaceæ, Thymelaceæ, Santalaceæ, Aristolochiaceæ, Empetraceæ, Euphorbiaceæ, Callitrichaceæ, Ceratophyllaceæ, Urticaceæ, Amentifereæ, and Conifereæ.

VOL. IX.—All the Plants ranked under the orders Typhaceæ, Araceæ, Lemnaceæ, Naiadaceæ, Alismaceæ, Hydrocharidaceæ, Orchidaceæ, Iridaceæ, Amaryllidaceæ, Dioscoreaceæ, and Liliaceæ.

VOL. X.—All the Plants ranked under the orders Juncaceæ and Cyperaceæ.

VOL. XI.—All the Plants ranked under the order Graminaceæ.

VOL. XII.—Marsiliaceæ, Isoetaceæ, Selaginellaceæ, Lycopodiaceæ, Ophioglossaceæ, Filices, Equisetaceæ, and Characeæ; and an Index to the whole Work.

VOL. XIII. (SUPPLEMENT).—Addenda to the earlier portion of the Work, including all the orders in Vols. I. to IV.

**THIS SPECIAL OFFER WILL BE SHORTLY WITHDRAWN.
NEARLY ALL THE HALF-MOROCCO SETS ARE ALREADY SOLD.**

ORDER FORM FOR MONTHLY PAYMENTS.

Date..... 1899.

All cheques should be crossed and made payable to C. Worsfold, NATURE Office, St. Martin's Street, W.C.

I enclose One Guinea as first payment for a copy of "Sowerby's English Botany" bound in { Cloth, 16 Guineas } (cross out one of these lines), and I agree to pay to you, or to your representative, the balance at the rate of One Guinea per month; my next payment to be on the delivery of the volumes, and my remaining payments on the corresponding day of each month following.

Until such payments are complete, I engage that the Work, not being my property, shall not be disposed of by sale or otherwise. I further agree that if it be found impossible for any reason to deliver the book, the return of the sum of One Guinea to me shall cancel this agreement.

Name

Address

Residents abroad are kindly requested to remit in full, or to instruct their representatives in England to make the monthly payments, in order to avoid expense and delay in forwarding cash from abroad.

NOW READY. NEW EDITION.

Crown 8vo, Cloth, price 7s. 6d.

PROPERTIES OF MATTER.

By PROF. P. G. TAIT,

Author of "Light," "Dynamics," &c.

Fourth Edition.

"The work . . . is well calculated to stimulate a student's reflective powers, and is a very able introduction to the study of physics."—*Westminster Review*.

NOW READY. Crown 8vo, Cloth, price 1s. 6d. net.

NEWTON'S LAWS OF MOTION.

By PROF. P. G. TAIT, M.A., Sec.R.S.E.,

Author of "Light," "Properties of Matter," and "Dynamics"

From the *Scotsman*.—"It should prove of considerable service to students in enabling them to obtain a mastery of the rudiments of their subject."

From *Literature*.—"It is something more than a text-book, and its author's name is a guarantee of its value."

NOW READY. PRICE 16s. net.

Cheap Issue in one handy volume, Demy 8vo, Cloth, 1232 pages.

A DICTIONARY OF BIRDS.

By ALFRED NEWTON, M.A., F.R.S.,

Professor of Zoology and Comparative Anatomy in the University of Cambridge.

Assisted by HANS GADOW, F.R.S. With Contributions from RICHARD LYDEKKER, B.A., F.R.S., CHARLES S. ROY, M.A., F.R.S., and ROBERT W. SHUFFELDT, M.D.

Containing 340 Illustrations and a Map.

"The most comprehensive review of the subject of ornithology extant, and in it will be found a concise summary on most of the important works of ornithology from the earliest times."—*Nature*.

In Demy 8vo, Boards, price 3s. 6d. net.

A CLASSIFICATION OF VERTEBRATA, RECENT AND EXTINCT.

With Diagnoses and Definitions, a Chapter on Geographical Distribution, and an Etymological Index.

By HANS GADOW, M.A., Ph.D., F.R.S.,

Strickland Curator and Lecturer on Zoology to the University, Cambridge.

"It is a book—it need hardly be said—for the student; it is simply a list of the principal sub-divisions of back-boned animals, with just as much definition as is needed. It may be regarded as an exceedingly concentrated extract of a full text-book of the vertebrates."—*The Daily Chronicle*.

Demy 8vo, Cloth, price 18s. net.

ZOOLOGY OF THE INVERTEBRATA.

A Text-Book for Students.

By A. E. SHIPLEY, M.A.,

Fellow and Assistant Tutor of Christ's College, and Demonstrator of Comparative Anatomy in the University of Cambridge.

Illustrated with 263 Figures.

"In classification, Mr. Shipley is convincing and ingenious. The book is well illustrated, well indexed, and conveniently arranged."—*Natural Science*.

A. & C. BLACK, SOHO SQUARE, LONDON, W.

SCOTTISH PROVIDENT INSTITUTION.

HEAD OFFICE: 6 St. Andrew Square, EDINBURGH.

MUTUAL ASSURANCE with MODERATE PREMIUMS.

More than one half of the Members who died during the Septennial period were entitled to Bonuses which, notwithstanding that the premiums do not as a rule exceed the non-profit rates of other Offices, were on the average equal to an Addition of about 50 per cent. to the Policies which participated.

The SURPLUS at last Division was £1,423,000.

Examples of Premium for £100 at Death, with Profits.

AGE.	30*	35	40	45	50	55
DURING LIFE,	£2 1 6	£2 8 10	£2 14 9	£3 5 9	£4 1 7	£5 1 11
25 PAYMENTS,	2 13 0	2 17 9	3 4 6	3 14 0	4 8 7	5 6 11
15 PAYMENTS,	3 12 1	3 18 0	4 5 8	4 16 2	5 11 8	6 9 11

*A person of 30 may secure £1000 at death by a yearly payment, during life, of £20 15s., which would in many Offices secure (with profits) £800 only. Or he may secure £1000 by 25 payments of £26 10s., being thus free of payment before age 55.

ACCUMULATED FUNDS, £11,000,000.

Prospectus, with full information, on application.

LONDON OFFICE: 17 KING WILLIAM STREET, E.C.

J. MUIR LEITCH, Secretary.

IMPROVED D'ARSONVAL GALVANOMETERS.PRICES
£10-0-0

AND

£4-10-0

LIBERAL DISCOUNTS.

Most SENSITIVE for DEFLECTIVE, ZERO, or BALLISTIC WORK.



Write for Price List and Particulars of Potentiometers Galvanometers, Electrical Thermometers, Experimental Direct and Alternating Current Sets, &c., to

CROMPTON & CO., LD.,Laboratory { "THRIPLANDS," } LONDON, W.
KENSINGTON COURT,

QUARTZ FIBRES.

We are now making **QUARTZ FIBRES** about 40 cm. long, capable of supporting a weight of 50 grammes. These are especially suitable for suspending heavy magnets.

Price of Box containing 6 of these Fibres,
£1 0 0

FIBRES SUITABLE FOR GALVANOMETER SUSPENSIONS.

In Box containing 6 Fibres 16 cm. long	-	5	0
" " " 30 "	-	7	6
" " " 40 "	-	10	0

SCIENTIFIC INSTRUMENT CO.
LIMITED,
CAMBRIDGE.

C. E. MÜLLER & CO., SCIENTIFIC GLASS BLOWERS

AND

Manufacturers of Chemical
and Physical Apparatus.

PATENT DOUBLE SURFACE CONDENSER

Extremely Small and Light,
Great Efficiency.

PARTICULARS OF ABOVE AND PRICE
LISTS OF APPARATUS ON
APPLICATION TO

148 HIGH HOLBORN,
LONDON, W.C.



Now Ready, large post 8vo, cloth, 6s. THE EVOLUTION OF GEOGRAPHY.

A Sketch of the Rise and Progress of Geographical Knowledge, from the Earliest Times to the First Circumnavigation of the Globe.

By **JOHN KEANE.**

WITH 19 MAPS, AND SEVERAL ILLUSTRATIONS.

London: EDWARD STANFORD, 26 and 27 Cockspur Street, S.W.,
Geographer to the Queen.

MR. SPENCER'S NEW VOLUME Will be issued immediately, 8vo, Cloth, price 18s. THE PRINCIPLES OF BIOLOGY.

VOLUME II.

Revised and Enlarged Edition.

By **HERBERT SPENCER.**

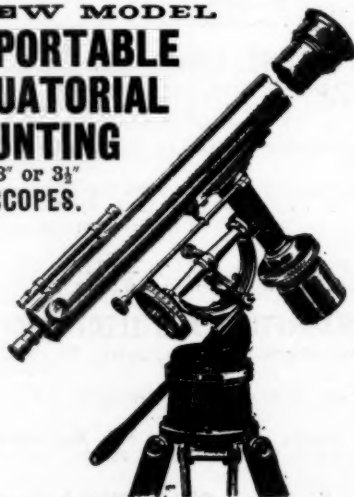
London: WILLIAMS & NORGATE, 14 Henrietta Street, W.C.

For Photography, Unsurpassed for fine definition.

COOKE LENSES

TAYLOR, TAYLOR, & HOBSON,
Stoughton Street Works, Leicester;
and 18 Berners Street, London, W.

NEW MODEL PORTABLE EQUATORIAL MOUNTING For 3" or 3½" TELESCOPES.



Latitude Adjustment, Clamp for Declination Axis, Quick and Slow Motion, in Right Ascension.

EQUATORIAL MOUNTING with Divided Circles and Stand fitted with short Iron Column, Levelling Screws, and Metal Stretcher, £15 15s.; or, complete with 3" Telescope, £25.

ILLUSTRATED CATALOGUE GRATIS.

J. H. STEWARD,
OPTICIAN,
406 STRAND, 457 WEST STRAND,
7 GRACECHURCH STREET, LONDON.

MACMILLAN & CO.'S SCIENCE CLASS BOOKS.

ADAPTED TO THE SOUTH KENSINGTON SYLLABUSES.

I.—PRACTICAL PLANE & SOLID GEOMETRY.

Practical Plane and Solid Geometry. By J. HARRISON, M.Inst.M.E., &c. Instructor in Mechanics and Mathematics, and G. A. BAXANDALL, Assistant Instructor Royal College of Science, London. Part I. ELEMENTARY. 2s. 6d. Part II. ADVANCED. 4s. 6d.

Test Papers in Practical Plane and Solid Geometry. Elementary Stage. By GEORGE GRACE, B.Sc. (Lond.). 24 Tests printed on Cartridge Paper. 2s.

III.—BUILDING CONSTRUCTION.

Building Construction for Beginners. By J. W. RILEY, Rochdale Technical School. 2s. 6d.

V.—MATHEMATICS.

An Elementary Course of Mathematics. Comprising Arithmetic, Algebra, and Euclid. By H. S. HALL, M.A., and F. H. STEVENS, M.A., Masters of the Military Side, Clifton College. 2s. 6d.

Graduated Test Papers in Elementary Mathematics. By WALTER J. WOOD, B.A. 1s.

Practical Mathematics. By F. CASTLE, M.I.M.E. 3s. 6d.

VI.—THEORETICAL MECHANICS.

Mechanics for Beginners. By W. GALLATLY, B.A. 2s. 6d.

Mechanics for Beginners. By Rev. J. B. LOCK, M.A. Part I. Mechanics and Solids. 2s. 6d.

Hydrostatics for Beginners. By F. W. SANDERSON, M.A. 2s. 6d.

VII.—APPLIED MECHANICS.

Lessons in Applied Mechanics. By Prof. J. H. COTTERILL, F.R.S., and J. H. SLADE. 5s. 6d.

VIII.—SOUND, LIGHT, AND HEAT.

Elementary Lessons in Heat, Light, and Sound. By D. E. JONES, B.Sc., Inspector of Science Schools under the Science and Art Department. 2s. 6d.

Heat for Advanced Students. By E. EDSEER, A.R.C.Sc. 4s. 6d.

Exercises in Practical Physics for Schools of Science. By Prof. R. A. GREGORY and A. T. SIMMONS, B.Sc. (Lond.). In two parts. Part I. First Year's Course. 2s. Part II. 2s.

Elementary Physics. By BALFOUR STEWART, F.R.S. New Edition, thoroughly Revised. 4s. 6d. Questions. 2s.

IX.—MAGNETISM AND ELECTRICITY.

Electricity and Magnetism for Beginners. By F. W. SANDERSON, M.A. 2s. 6d.

Magnetism and Electricity for Beginners. By H. E. HADLEY, B.Sc. (Lond.). 2s. 6d.

Elementary Lessons in Electricity and Magnetism. By Prof. SILVANUS P. THOMPSON, F.R.S. New Edition. 4s. 6d.

X. & XI.—CHEMISTRY.

INORGANIC CHEMISTRY—THEORETICAL.

Chemistry for Beginners. By Sir HENRY ROSCOE, F.R.S., assisted by J. LUNT, B.Sc. New Edition, revised. 2s. 6d.

The Elements of Chemistry. By Prof. IRA REMSEN. 2s. 6d.

Inorganic Chemistry for Advanced Students. By Sir H. E. ROSCOE, F.R.S., and Dr. A. HARDEN. 4s. 6d.

X & XI.—CHEMISTRY—continued.

Chemical Problems. By Prof. T. E. THORPE, F.R.S. With Key. 2s.

Chemical Arithmetic. By S. LUPTON, M.A. With 1200 Problems. 4s. 6d.

Inorganic Chemistry. By Prof. IRA REMSEN. 6s. 6d.

INORGANIC CHEMISTRY—PRACTICAL.

Chemistry for Organised Schools of Science. By S. PARRISH, B.Sc., A.R.C.S. (Lond.), with Introduction by Dr. FORSYTH. 2s. 6d.

Practical Inorganic Chemistry. By G. S. TURPIN, M.A., D.Sc. 2s. 6d.

Practical Inorganic Chemistry for Advanced Students. By CHAPMAN JONES, F.I.C., F.C.S. 2s. 6d.

The Junior Course of Practical Chemistry. By F. JONES, F.C.S. 2s. 6d. The New Edition of this book covers the Syllabus of the South Kensington Examination.

ORGANIC CHEMISTRY—THEORETICAL.

Organic Chemistry for Beginners. By G. S. TURPIN, M.A., D.Sc. 2s. 6d.

Organic Chemistry. By Prof. IRA REMSEN. 6s. 6d.

XII.—GEOLOGY.

Geology for Beginners. By W. W. WATTS, M.A., F.G.S. 2s. 6d.

XIV.—HUMAN PHYSIOLOGY.

Physiology for Beginners. By Sir MICHAEL FOSTER, K.C.B., and Dr. L. E. SHORE. 2s. 6d.

Physiology for Advanced Students. By A. STANLEY KENT, M.A. (Oxon.). [In preparation.]

Lessons in Elementary Physiology. By the Right Hon. T. H. HUXLEY, F.R.S. 4s. 6d. Questions. 1s. 6d.

XVII.—BOTANY.

Botany for Beginners. By ERNEST EVANS, Burnley Technical School. 2s. 6d.

XIX.—METALLURGY.

A Text-Book of Elementary Metallurgy. By A. H. HIORNS, Principal of the School of Metallurgy, Birmingham and Midland Institute. 3s. Questions. 1s.

XXIII.—PHYSIOGRAPHY.

Experimental Science (Section I. Physiography). By Prof. R. A. GREGORY and A. T. SIMMONS, B.Sc. 2s. 6d.

Physiography for Beginners. By A. T. SIMMONS, B.Sc. 2s. 6d.

Physiography for Advanced Students. By A. T. SIMMONS, B.Sc. 4s. 6d.

Elementary Lessons in Astronomy. By Sir NORMAN LOCKYER, K.C.B. New Edition. 5s. 6d. This book contains all the Astronomy required for the Advanced and Honours Stages.

XXIV.—THE PRINCIPLES OF AGRICULTURE.

Agriculture for Beginners. By A. J. COOPER, Harris Institute, Preston. [In preparation.]

Elementary Lessons in the Science of Agricultural Practice. By H. TANNER, F.C.S. 3s. 6d.

XXV.—HYGIENE.

Hygiene for Beginners. By E. S. REYNOLDS, M.D. 2s. 6d.

Handbook of Public Health and Demography. By E. F. WILLOUGHBY, M.B. New and Revised Edition. 4s. 6d.

MACMILLAN AND CO., LIMITED, LONDON.

MACMILLAN & CO.'S NEW BOOKS.

VOLUME II. NOW READY.

THE SCIENTIFIC MEMOIRS

OF

THOMAS HENRY HUXLEY.

Edited by Prof. Sir MICHAEL FOSTER, K.C.B., and Prof. E. RAY LANKESTER, M.A., LL.D.

In Four Volumes. Vol. I., 25s. net. Vol. II. With PORTRAIT. Super Royal 8vo, 30s. net.

. Sold in Sets only.

THE WAR IN SOUTH AFRICA.

A HISTORY OF THE BRITISH ARMY.

By the Hon. J. W. FORTESCUE.

First Part.—To the Close of the Seven Years' War. In Two Vols. With numerous Maps and Plans. 8vo, 36s. net.

DAILY NEWS.—"It is sound, admirable workmanship, a book for which every reader of the nation's history will heartily thank its author."

Third Edition, with a new Prefatory Chapter, dealing with the events which have induced the present Crisis.

IMPRESSIONS of SOUTH AFRICA.

By the Right Hon. JAMES BRYCE, M.P.

With Three Maps, and with the Text of the Transvaal Conventions of 1881 and 1884. Crown 8vo, 6s.

SOUTH AFRICA OF TO-DAY.

By Captain FRANCIS YOUNGHUSBAND, C.I.E.,

Indian Staff Corps, late Special Correspondent of the *Times* in South Africa. With Illustrations. Demy 8vo, 8s. 6d. net.

HIGHWAYS AND BYWAYS SERIES NEW VOLUME.

HIGHWAYS AND BYWAYS IN YORKSHIRE.

By ARTHUR H. NORWAY.

With Illustrations by JOSEPH PENNELL and HUGH THOMSON. Extra crown 8vo, gilt top, 6s.

INTRODUCTION TO PHYSICAL CHEMISTRY.

By JAMES WALKER, D.Sc.,

Ph.D., Professor of Chemistry in University College, Dundee. 8vo, 10s. net.

SECOND EDITION NOW READY.

A HANDBOOK OF GOLD MILLING.

By HENRY LOUIS, M.A., Associate of

the Royal School of Mines, &c. Crown 8vo, 10s. net.

SOUTH AFRICA.—"For a reasonably priced handbook on gold milling, we know no better one than this. . . . The book should become the *vaude macum* of either the student or the practical working man."

THE STEAM ENGINE AND GAS AND OIL ENGINES.

A Book for the use of Students who have time to make Experiments and Calculations. By JOHN PERRY, D.Sc., F.R.S., Professor of Mechanics and Mathematics in the Royal College of Science. Illustrated. 8vo, 7s. 6d. net.

INDUSTRIES AND IRON.—"It will be obtained by all those entering for the Science Examination, but it should be in the hands of all young men serving their apprenticeship to the construction of steam engines. . . . The figures in the text are very good. There is a good index, and the text is interspersed with exercises which fix the ideas in the mind."

SOCIAL LAWS.

An Outline of Sociology. By G. TARDE. Translated from the

French by HOWARD C. WARREN, with a Preface by JAMES MARK BALDWIN. Globe 8vo, 5s.

SECOND EDITION, RE-WRITTEN AND ENLARGED.

DEVELOPMENT AND CHARACTER OF GOTHIC ARCHITECTURE.

By PROFESSOR CHARLES HERBERT MOORE. With 10 Plates in Photogravure and 242 Illustrations in the Text. 8vo, 18s. net.

EUCLID'S ELEMENTS OF GEOMETRY.

Edited for the use of Schools by CHARLES SMITH, M.A., and SOPHIE BRYANT, D.Sc. Globe 8vo. Book I., 1s.; Books I. and II., 1s. 6d.; Books I.-IV., 3s.

MACMILLAN AND CO., LIMITED, LONDON.

MACMILLAN & CO.'S BOOKS FOR STUDENTS OF ZOOLOGY. THE CAMBRIDGE NATURAL HISTORY.

EDITED BY S. F. HARMER, M.A., AND A. E. SHIPLEY, M.A.

TO BE COMPLETED IN TEN VOLUMES. 8VO. PRICE 17S. NET EACH.

NEW VOLUME JUST PUBLISHED. VOLUME VI.

INSECTS.

Part II. Hymenoptera continued (Tubulifera and Aculeata), Coleoptera, Strepsiptera, Lepidoptera, Diptera, Aphaniptera, Thysanoptera, Hemiptera, Anoplura.

By DAVID SHARP, M.A. Cantab., M.B. Edin., F.R.S.

WORMS, LEECHES, &c.

VOLUME II.

Flatworms. By F. W. GAMBLE, M.Sc. Vict., Owens College.
Nemertines. By Miss L. SHELDON. Threadworms, &c. By A. E. SHIPLEY, M.A. Rotifers. By Professor MARCUS HARTOG, M.A., D.Sc. Lond. Polychaet Worms. By W. BLAXLAND BENHAM, D.Sc. Lond., Hon. M.A. Oxon. Earthworms and Leeches. By F. E. BEDDARD, M.A. Oxon., F.R.S. Gephyrea, &c. By A. E. SHIPLEY, M.A. Polyzoa. By S. F. HARMER, M.A.

* * The remaining five volumes, dealing with PROTOZOA (including Sea Anemones, Jelly Fish, Star Fish, &c.); SPIDERS, SCORPIONS, and CRUSTACEA; FISHES and THEIR KINDRED; AMPHIBIA and REPTILES; and MAMMALS, are all in active preparation.

A TEXT-BOOK OF ZOOLOGY. By T. JEFFERY PARKER, D.Sc., F.R.S., Professor of Biology in the University of Otago, Dunedin, N.Z., and WILLIAM A. HASWELL, M.A., D.Sc., F.R.S., Professor of Biology in the University of Sydney, N.S.W. In Two Vols. With Illustrations. Medium 8vo, 36s. net.

A COURSE of INSTRUCTION in ZOOTOMY. Vertebrata. By Professor T. JEFFERY PARKER, F.R.S. With Illustrations. Crown 8vo. 8s. 6d.

A TEXT-BOOK OF COMPARATIVE ANATOMY. By Dr. ARNOLD LANG, Professor of Zoology in the University of Zürich. With Preface to the English Translation by Dr. ERNST HAECKEL. Translated by HENRY M. BERNARD, M.A. Cantab., and MATILDA BERNARD. Vols. I. and II. (completing the Invertebrates). 8vo. 17s. net each.

LESSONS in ELEMENTARY ANATOMY. By ST. GEORGE MIVART, F.R.S. Fcap. 8vo. 6s. 6d.

ELEMENTS of the COMPARATIVE ANATOMY OF VERTEBRATES. Adapted from the German of Professor WIEDERSHEIM. By Professor W. NEWTON PARKER. With additions by the Author and Translator. 270 Woodcuts. Medium 8vo. Second Edition. 12s. 6d. net.

The STRUCTURE of MAN: An INDEX to his PAST HISTORY. By Prof. WIEDERSHEIM. Translated by H. and M. BERNARD. The Translation, Edited and Annotated, and a Preface written by Professor G. B. HOWES, F.R.S. With 105 Figures in the Text. 8vo. 8s. net.

An INTRODUCTION to the OSTEOLOGY OF THE MAMMALIA. By Sir WILLIAM HENRY FLOWER, F.R.S., F.R.C.S. Illustrated. Third Edition. Revised with the assistance of HANS GADOW, Ph.D. Crown 8vo. 10s. 6d.

ESSAYS ON MUSEUMS AND OTHER SUBJECTS CONNECTED with NATURAL HISTORY. By Sir WILLIAM HENRY FLOWER, K.C.B., D.C.L., D.Sc. Demy 8vo. 12s. net.

SHELLS.

VOLUME III.

Molluscs and Brachiopods. By the Rev. A. H. COOKE, M.A., A. E. SHIPLEY, M.A., and F. R. C. REED, M.A.

INSECTS & CENTIPEDES.

VOLUME V.

Peripatus. By ADAM SEDGWICK, M.A., F.R.S. Myriapods. By F. G. SINCLAIR, M.A. Insects. Part I. By DAVID SHARP, M.A., Cantab., M.B. Edin., F.R.S.

BIRDS.

VOLUME IX.

By A. H. EVANS. With numerous Illustrations by G. E. LODGE.

A TREATISE on COMPARATIVE EMBRYOLOGY. By the late Prof. F. M. BALFOUR, M.A., F.R.S. In two Vols. Second Edition. Medium 8vo. Vol. I. 18s. Vol. II. 21s.

The ELEMENTS of EMBRYOLOGY. By Sir MICHAEL FOSTER, K.C.B., M.D., F.R.S., and the late Prof. F. M. BALFOUR, F.R.S. Second Edition, revised. Edited by A. SEDGWICK, M.A., and W. HEAPE, M.A. Illustrated. Crown 8vo. 10s. 6d.

FISHES, LIVING and FOSSIL. An Outline of their Forms and probable Relationships. By BASHFORD DEAN, Ph.D., Instructor in Biology, Columbia College, New York City. 8vo. 10s. 6d. net.

The NATURAL HISTORY of the MARKETABLE MARINE FISHES of the BRITISH ISLANDS. By J. T. CUNNINGHAM, M.A. With Preface by E. RAY LANKESTER, F.R.S. Illustrated. Medium 8vo. 7s. 6d. net.

A TEXT-BOOK of ENTOMOLOGY, including the Anatomy, Physiology, Embryology and Metamorphoses of Insects, for use in Agricultural and Technical Schools and Colleges, as well as by the working Entomologist. By ALPHEUS S. PACKARD, M.D., Ph.D., Professor of Zoology and Geology, Brown University. Medium 8vo. 18s. net.

NATURAL HISTORY of AQUATIC INSECTS. By L. C. MIALL, F.R.S., Professor of Biology in the Yorkshire College, Leeds. Illustrated. Crown 8vo. 6s.

THE ORIGIN AND METAMORPHOSES OF INSECTS. By Sir JOHN LUBBOCK, F.R.S. With Illustrations. 3s. 6d. (Nature Series).

MACMILLAN AND CO., LIMITED, LONDON.

CO-OPERATIVE WORLD TRAVEL

Organised by HENRY S. LUNN, M.D., F.R.G.S.,
W. HOLDSWORTH LUNN, & CONNOP F. S. PEROWNE.

A Cruise to the WESTERN MEDITERRANEAN.

TILBURY, LISBON, TANGIER, GIBRALTAR, ALGIERS, PALMA,
MARSEILLES.

A FOURTEEN DAYS' CRUISE FOR £11 11s. AND UPWARDS.

A Cruise to the EASTERN MEDITERRANEAN.

(Return ticket to MARSEILLES included.)

MARSEILLES, SYRACUSE, PIRÆUS (for Athens),
CONSTANTINOPLE, JAFFA (for Jerusalem), ALEXANDRIA,
MALTA, NAPLES, MARSEILLES.

A THIRTY-FIVE DAYS' CRUISE FOR £36 15s. AND UPWARDS
s.v. ARGONAUT. Tonnage, 3254; h.-p., 4000.

Full particulars from the Secretary, 5 Endsleigh Gardens,
Euston, London, N. W.

LIVING SPECIMENS FOR THE MICROSCOPE.

Volvox, Spirogyra, Desmids, Diatoms, Amoeba, Arcella, Actinosphaerium,
Vorticella, Stentor, Hydra, Euscula, Stephanoceros, Melicerta, and many
other Specimens of Pond Life. Price 1s. per Tube, Post Free. Helix
pomatia, Astacus, Amphioxus, Rana, Anodon, &c., for Dissection purposes.

THOMAS BOLTON,

25 BALSALL HEATH ROAD, BIRMINGHAM.

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM. THE LABORATORY, PLYMOUTH.

The following animals can always be supplied, either living
or preserved by the best methods:—

Sycon; Clava, Obelia, Sertularia; Actinia, Tealia, Caryophyllia, Alcy-
onium; Hormiphora (preserved); Leptoplana; Lineus, Amphiporus; Nereis,
Aphrodite, Arenicola, Lanice, Terebella; Lepas, Balanus, Gammarus,
Ligia Myis, Nebalia, Carcinus; Patella, Buccinum, Eledone, Pectens
Bugula, Crisia, Pedicellina, Holothuria, Asterias, Echinus; Ascidia, Salpa
(preserved), Scyllium, Raja, &c., &c.

For prices and more detailed lists apply to
Biological Laboratory, Plymouth.

THE DIRECTOR.

THE MOST NUTRITIOUS.

E P P S'S

GRATEFUL—COMFORTING.

C O C O A

BREAKFAST—SUPPER.

HOLLOWAY'S PILLS

CURE

Biliousness, Sick Headache, Indigestion, and
all Internal Complaints.

CAN BE TAKEN BY THE MOST DELICATE.

Holloway's Pills and Ointment may be obtained of
all Medicine Vendors.

NOTICE.—Advertisements and business letters for NATURE should be addressed to the Publishers; Editorial
communications to the Editor. The telegraphic address of NATURE is "PHUSIS," LONDON.

SUBSCRIPTIONS TO "NATURE."

	£	s.	d.
Yearly	1	8	0
Half-yearly	0	14	6
Quarterly	0	7	6
TO ALL PLACES ABROAD:—			
Yearly	1	10	6
Half-yearly	0	15	6
Quarterly	0	8	0

Cheques and Money Orders payable to MACMILLAN & CO., Limited.

OFFICE: ST. MARTIN'S STREET, LONDON, W.C.

WATKINS & DONCASTER,

NATURALISTS,

AND MANUFACTURERS OF.

CABINETS AND APPARATUS

FOR ENTOMOLOGY, BIRDS' EGGS, AND ALL BRANCHES OF
NATURAL HISTORY.

SPECIAL SHOW-ROOM FOR CABINETS.

Call or send for detailed Catalogue (66 pp.), Post free on
application.

N.B.—For Excellence and Superiority of Cabinets and
Apparatus, references are permitted to distinguished
patrons, Museums, Colleges, &c.

A LARGE STOCK OF INSECTS AND BIRDS' EGGS.

Birds, Mammals, &c., Preserved and Mounted by First-class Workmen
with true natural surroundings. All Books and Publications on Natural
History supplied.

36 STRAND, LONDON, W.C.
(Five Doors from Charing Cross.)

CABINETS

ENTOMOLOGICAL AND ALL BRANCHES OF NATURAL HISTORY.

J. T. CROCKETT & SON are ACTUAL MAKERS.

Great advantages in dealing direct with them.

ALL BEST WORK. ESTIMATES GIVEN.

SEND for Full DETAILED PRICE LIST BEFORE ORDERING ELSEWHERE.

7a PRINCES STREET, CAVENDISH SQUARE, LONDON, W.

Factories: 34 Riding House Street and Ogle Street, W.

MINERALS, ROCKS & FOSSILS.

COLLECTIONS FOR STUDENTS.

Carefully labelled and arranged in Boxes with Card Trays.

50 Minerals, 12/6; 100 do., 21/-; 200 do., 42/-.

Rocks and Fossils at similar prices.

300 Minerals in Cabinet, £4 4s.; 400 do., £5 12s. 6d.

Catalogues Post Free.

THOMAS D. RUSSELL,

78 NEWGATE STREET, LONDON, E.C.

PHYSIOGRAPHY and GEOLOGY.

COLLECTIONS & MICROSCOPIC SLIDES,

As advised by Science and Art Directory, arranged by

JAMES R. GREGORY & CO.,

Mineralogists, &c.,

To Science and Art Department, British, Indian and Colonial
Museums, &c.

NOVELTIES and RARE GEMS and PRECIOUS
STONES.

Mineral Specimens for Museums, and Collectors, and all purposes.

Rock Specimens and Microscopic Sections of Rocks and Minerals
cut to order.

NEW AND VALUABLE MINERAL SPECIMENS CONSTANTLY
ARRIVING.

Stores & Offices: 1 Kelso Place, KENSINGTON, W.
NEW CATALOGUES AND LISTS FREE.

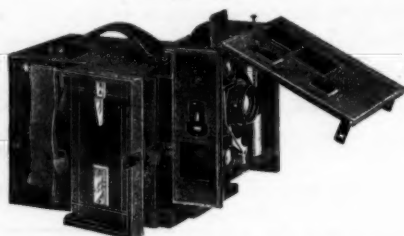
CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
*Three Lines in Column	0	2	6
Per Line after	0	0	9
One Eighth Page, or Quarter Column	0	18	6
Quarter Page, or Half a Column	1	15	0
Half a Page, or a Column	3	5	0
Whole Page	6	6	0

* The first line being in heavy type is charged for as Two Lines.

THE "N. & G." CAMERAS FOR HAND AND TRIPOD.

In all sizes up to 7 x 5 in. For Plates, Cut Films or Film in Spools.
A Series of High-Class Instruments for SERIOUS WORK, embodying every New Advance in Photography.
Prices from £13 to £50.
Have been in Constant Use FOR EIGHT YEARS in all Parts of the World.



"N. & G." Camera, open, to show Fittings and Movements.

**TRIPOD CAMERAS,
SURVEYING CAMERAS,
and very Small and Light
POCKET CAMERAS**
for Travellers and Field Naturalists.

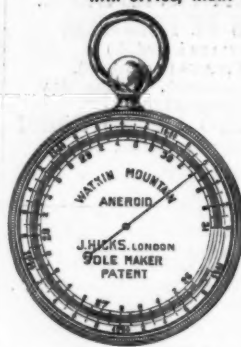
SPECIALITY: COMPLETE OUTFITS for Scientific Expeditions and Special Research.

Catalogues and Estimates free on application.
Lenses, Kinematographs, Lanterns, and all Photographic Accessories and Materials.

NEWMAN & GUARDIA, Ltd.,
90 & 92 Shaftesbury Avenue, London, W.

JAS. J. HICKS, 8, 9 & 10 HATTON GARDEN, LONDON, SCIENTIFIC INSTRUMENT MAKER

TO THE
WAR OFFICE, INDIA OFFICE, ADMIRALTY, &c.,
IS SOLE MAKER OF THE
NEW PATENT
"WATKIN"
MOUNTAIN ANEROID
BAROMETER.



The Barometer that all the World has been waiting for, and the only Aneroid that can be thrown in and out of action as required, and which, when out of action, is absolutely impervious to the influence of variations in atmospheric pressure. Travellers and Surveyors will now be able to ascertain correct altitudes owing to the marvellous accuracy of this Instrument, which is described at length by Mr. WHYMFER, the distinguished Alpine climber, in the "Times" of Dec. 17, 1898. In 65 readings taken between 1227 and 10,289 feet above the sea, the mean error ascertained by comparison

with the Mercurial Barometer was never so much as 0.1 of an inch. He says: "Extraordinary results may be obtained from Watkin's Mountain Aneroid in observations made for altitude, and in determining differences of level."

"It is beyond doubt a wonderful instrument," &c. (Press).

It is made in Aluminium for lightness, in either 3-inch or 4½-inch sizes, with Sling Leather Case, and supplied at the following prices:—Scale to 5000 feet, £5 5s. To 10,000 feet, £5 10s. To 15,000 feet, £5 15s. To 20,000 feet, £6.

N.B.—Orders will be executed for this Instrument strictly in the rotation in which they are received.

Full particulars on application.

OPPOSITE THE BRITISH MUSEUM.

THACKERAY HOTEL

(TEMPERANCE).

GREAT RUSSELL STREET, LONDON.

THIS newly-erected and commodious Hotel will, it is believed, meet the requirements of those who desire all the conveniences and advantages of the larger modern licensed hotels at moderate charges. Passenger Lift. Electric Light in all Rooms. Bath-rooms on every Floor. Spacious Dining, Drawing, Writing, Reading, and Smoking Rooms. All Floors Fireproof. Perfect Sanitation. Night Porter. Telephone. Bedrooms from 2s. 6d. to 4s. 6d. per night. Full Tariff and Testimonials on application.

Telegraphic Address: "THACKERAY, LONDON."

Proprietor—J. TRUSLOVE.

Also, amalgamated with, and under the same management,

ESMOND HOTEL

(TEMPERANCE).

MONTAGUE STREET, RUSSELL SQUARE.

THIS Hotel, which has been carried on so successfully for the last 13 years, adjoins the British Museum, and is exceptionally quiet. Bedrooms from 2s. to 3s. 6d. per night. Full Tariff and Testimonials on application.

Telegraphic Address: "TRUSLOVE, LONDON."

Proprietor—J. TRUSLOVE.

TO SCIENTIFIC MEN, NATURALISTS, TRAVELLERS, AND OTHERS.

TWIN-LENS HAND CAMERAS ARE NECESSITIES.

THE ARTIST IMPROVED TWIN-LENS

The Smallest Twin-Lens Hand Camera in the World.

It measures only 5½ by 6 by 8½ in. and weighs 4 lbs., including three slides, two lenses, and shutter.

It is made of the very finest mahogany, carefully covered in Morocco leather, and is fitted with a full-size finder and an ordinary focussing screen in addition, so that it is not only the most practical hand camera, but an equally useful stand ditto. There are three Double Dark Slides, of excellent make and design, or a Changing Box, holding 12 plates or 20 films; a pair of "Black Band" Rapid Euryscope Lenses, working at f/5.6; and a Thornton-Pickard Shutter, with Time and Instantaneous movements and speed regulator, which can be removed at will. There is a strap for carrying the Camera round the neck when in use, so as to leave the hands at liberty.

Costs £14 14s. inclusive

Taking Pictures 4½ by 2½. This Camera can also be supplied in 3 by 4 and 4½-size sizes.
SOLID LEATHER CASE, WITH LOCK, KEY AND HANDLE, 25s. EXTRA.

FREE LESSONS OR DEMONSTRATIONS TO PURCHASERS.

THE STEREOSCOPIC COMPANY

106 and 108 REGENT STREET, W., and 54 Cheapside, E.C.



CATALOGUE FREE.



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 1570, VOL. 61]

THURSDAY, NOVEMBER 30, 1899.

[PRICE SIXPENCE.

Registered as a Newspaper at the General Post Office.]

[All Rights are Reserved.

THE TRANSVAAL AND THE WAR.

NEW LANTERN SLIDES. Plain Slides, 12, each.

- | | | | |
|----|--|----|--|
| 53 | Estcourt: General View. | 66 | Ambulance Wagon on the Way to Elands-laagte. |
| 54 | General Symons. | 67 | Enemy's Shell Bursting by Gen. White. |
| 55 | General Buller Embarking. | 68 | Devons, Manchester and Gordons Charging the Boer Guns. |
| 56 | General Piet Joubert. | 69 | Advance of Gordons at Elands-laagte. |
| 57 | Boers Surprising a British Provision Train. | 70 | Charge of 5th Lancers. |
| 58 | Ladysmith Camp: Serving out Rations to Men of the Border Mounted Rifles. | 71 | C Squadron of 5th Lancers among the Boers. |
| 59 | Pietermaritzburg: General View. | 72 | Tapping the Telegraph Wires. |
| 60 | Boer Prisoners on the Way to Pietermaritzburg. | 73 | Charge of Cavalry at Bester's Farm. |
| 61 | Hussar Advance Guard. | 74 | 10th Hussars Steaming out of Liverpool. |
| 62 | Cape Mounted Rifles. | 75 | "Three Cheers for the Queen." Her Majesty Inspecting the Household Brigade at Windsor. |
| 63 | Naval Brigade, Ladysmith. | | |
| 64 | Troops on the Way to Elands-laagte. | | |
| 65 | The Gordon's March to Elands-laagte. | | |

This List will be added to as the War proceeds.

THE TRANSVAAL WAR FUND.

By special arrangement with the *Daily Mail*, Lantern Slides of Kipling's War Poem, "The Absent-minded Beggar," and Canon Woodville's Illustration, "The Gentleman in Khaki," are published by Messrs. NEWTON & Co. at 5s. each. 4s. of this amount will be paid to the

"DAILY MAIL" WAR FUND.

Messrs. NEWTON & CO., of 3 Fleet Street, Lnd n, have the Sole Right to make Slides from Pictures of the *Illustrated London News* and *Sketch*, &c.

BECK'S NEW MICROSCOPE THE "BRITISH STUDENTS."

Microscope Stand No. 55, as figured, with Iris Diaphragm, One Eye-piece; Double Nose-piece, Two Object-glasses, 2/3" and 1/6", adjusted to be in about focus, and the whole packed in polished Mahogany Case,

£6 : 8 : 6

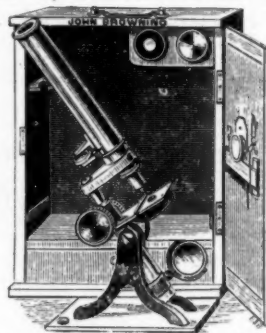


No. 55.

R. & J. BECK, Ltd.,
68 CORNHILL, LONDON, E.C.

BROWNING'S

"PERFECT"



MICROSCOPE.

The body is made entirely of brass and gun-metal, with rack-motion and fine screw adjustment. Three achromatic powers (separable) of excellent defining power, 1-inch, 1/2-inch, and 1/4-inch; adjusting slide-holder to stage, revolving diaphragm, hand-forep, stage-forep, live-cage, &c. The whole packed in upright Mahogany Cabinet, with drawer for slides, dissecting-knives, &c.

PRICE £3 15s. 0d.

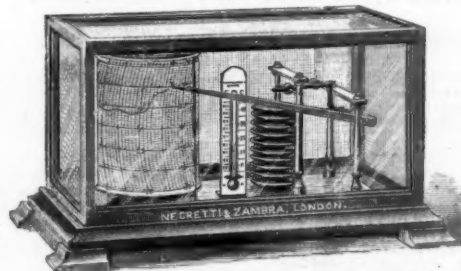
New Illustrated Catalogue of Microscopes free.

JOHN BROWNING, 63 STRAND, LONDON, W.C.

CHRISTMAS PRESENTS.

NEGRETTE & ZAMBRA'S Self-Registering
Barometers, Thermometers and Rain Gauges.

Giving continuous Records on Charts, and only requiring attention once a week.



THE LARGE SIZE BAROGRAPH, £7 10 0

Accurate Thermometers for all purposes.

"Special" Illustrated Price List of Instruments, suitable for Presents, free by post to all parts of the World.

38 HOLBORN VIADUCT, E.C.

BRANCHES—45 CORNHILL, and 122 REGENT STREET.

THE DAVY-FARADAY RESEARCH LABORATORY

OF THE
ROYAL INSTITUTION.

DIRECTORS:

The Right Hon. LORD RAYLEIGH, M.A., D.C.L.,
LL.D., F.R.S.

Professor DEWAR, M.A., LL.D., F.R.S.

SUPERINTENDENT OF THE LABORATORY:

Dr. ALEXANDER SCOTT, M.A., D.Sc., F.R.S.

This Laboratory was founded by Dr. Ludwig Mond, F.R.S., as a Memorial of Davy and Faraday, for the purpose of promoting, by original research, the development and extension of Chemical and Physical Science. The Laboratory is open free of charge to Workers of either sex, and any nationality, prosecuting individual investigations; and the extensive collection of Physico-Chemical Apparatus presented by the Founder is available for their use, together with such materials, chemicals, electricity, &c., as the Directors may authorise.

Assistants and a trained mechanic are attached to the Laboratory to aid Workers in the prosecution of their researches.

All persons desiring to be admitted as Workers must send evidence of scientific training, qualification, and previous experience in original research, along with a statement of the nature of the investigation they propose to undertake.

Michaelmas Term.—Monday, October 2, to Saturday, December 16.

Leam Term.—Monday, January 8, to Saturday, April 7.

Easter Term.—Monday, April 30, to Saturday, July 28.

Forms of Application can be had from the ASSISTANT SECRETARY, Royal Institution, Albemarle Street, W.

BACTERIOLOGY.

BACTERIOLOGICAL DEPARTMENT, KING'S COLLEGE, LONDON.

Director: PROF. CROOKSHANK.

The Laboratories are open daily for **Instruction and Research** from 10 a.m. to 5 p.m. For Syllabus of Classes apply THE SECRETARY. For Information and Advice as to the Course of Instruction to be selected, application must be made in writing to PROF. CROOKSHANK, or an interview may be obtained by appointment.

SPECIAL CLASSES IN JANUARY.

Two complete Courses of Practical Instruction for Medical Practitioners, Veterinary Surgeons, Analysts, &c., will commence on January 8th.

Demonstrations to the Morning Class (Dr. NEWMAN, D.P.H.) will be given at 11 a.m., and to the Afternoon Class (Dr. NASH, D.P.H.) will be given at 2 p.m.; three days' work, with practical work daily in the Laboratory for THIRTY DAYS.

A Class for Candidates for the D.P.H. (Bacteriology) will commence on January 8th at 10 a.m., and a Time Table arranged to suit the convenience of the Class.

A Class in Clinical Bacteriology, consisting of Demonstrations with practical work, will commence on Wednesday, January 10th (2 to 3.30), and be held on successive Wednesdays for six weeks.

B.A. AND B.Sc. MATRICULATION, INTERMEDIATE, FINAL.

PREPARATION BY CORRESPONDENCE AND ORAL TUITION on a THOROUGHLY INDIVIDUAL SYSTEM. Fees based on success.

The STAFF includes Graduates of Oxford, Cambridge, London, and Royal Universities, Science Medallists, Prizemen, Scholars, &c.

SINGLE SUBJECTS TAKEN: Latin, Greek, French, German, Mathematics, Science, Logic, Psychology, Political Economy, &c.

For Terms, &c., address Mr. J. CHARLESTON B.A. (Lond. and Oxon.), The Burlington Classes, 27 Chancery Lane, London, W.C.

Telegrams—"Tunzelmann, London."

THE GENERAL ENGINEERING COMPANY, LTD.,

2 and 4 PENYWERN ROAD, LONDON, S.W.

G. W. DE TUNZELMANN, Managing Director.

Mechanical, Electrical and Chemical Patents experimentally developed and Models constructed for Inventors. Special Machinery and Apparatus designed and carried out to Specification. Every description of Accurate work. Repetition work with all parts interchangeable.

HEATHCOTE SCIENCE LABORATORIES.

These Laboratories are open for RESEARCH work, at any hours or times most convenient for worker, in **CHEMISTRY, PHYSICS and BACTERIOLOGY**. Facilities for Commercial investigations are supplied. Furnaces and powerful Electrical Currents can be used.

The Fees are at rate of £2 3s. for one month (five days a week, six hours a day). Apparatus supplied free.

Private Laboratory, £4 14s. 6d. a month, or by arrangement.

The above Fees include use of all ordinary Glass and other Apparatus, and use of Accurate Balances and Standard General Instruments, also Furnaces, &c.

9 Heathcote Street, Mecklenburgh Square,
Gray's Inn Road, W.C.

R. C. T. EVANS,
Director.

BIRKBECK INSTITUTION, Breame Buildings, Chancery Lane, E.C.

Science Classes with Practical Work.

DAY AND EVENING CLASSES for University of London B.Sc.; Prelim. Scientific, Inter. M.B. Examinations and for Conjoint Board, Dental and Pharmaceutical Examinations.

EVENING CLASSES in all stages for Science and Art Department Examinations.

HIGHLY-EQUIPPED LABORATORIES.

Chemistry, Physics, Biology (Zoology and Botany), Metallurgy, Geology and Mineralogy, Microscopy.

Prospectus free. Calendar 6d. (Post 8d.) on application to Secretary.

UNIVERSITY COLLEGE OF NORTH WALES.

(A CONSTITUENT COLLEGE OF THE UNIVERSITY OF WALES.)

Applications are invited for the **CHAIR of PHYSICS** now Vacant in this College. The Council will elect on December 20th. Forty copies of the Application and Testimonials to be in the hands of the undersigned not later than Monday, December 4th. The Professor will be expected to enter on his duties at the beginning of the New Year. For further particulars apply to

JOHN EDWARD LLOYD, M.A., Secretary and Registrar.

Bangor, November 8th, 1899.

UNIVERSITY COLLEGE, BRISTOL.

The Council are prepared to appoint a **PROFESSOR of ENGINEERING** in succession to Dr. RYAN, who has been appointed Principal of the Woolwich Polytechnic.

Applications, accompanied by copies of not more than six testimonials, should reach the undersigned on or before December 9. The successful candidate will probably be required to enter upon his duties on January 16, 1900. Particulars as to duties, &c., may be obtained on application.

JAMES RAFTER, Secretary.

Required shortly in a Scientific Department

in the Colonies, a capable **TECHNICAL ASSISTANT**. Age 23 to 35. Qualifications: Preferably a Graduate in Natural Science Honours; well informed in current Scientific work, chiefly Biological; proficient in French and German; and with good experience in correcting and editing papers for the press—latter essential. Salary, £300 to £400, according to experience, with a First Class Passage.—Address, stating full particulars, to Mr. HARRIES, 63 Victoria Street, S.W.

CIVIL SERVICE COMMISSION.

FORTHCOMING EXAMINATION.

ASSISTANT in the NAUTICAL ALMANAC OFFICE of the ADMIRALTY (12-25), DECEMBER 14.

The date specified is the latest at which applications can be received. They must be made on forms to be obtained, with particulars, from the SECRETARY, Civil Service Commission, London, S.W.

SCHOLASTIC.—Physics Master Wanted

in January for an important London School. A Candidate is looked for who is a University man, and who has had a good practical training in Experimental work. Salary, £180 to start with.—Apply to Messrs. GABBITAS, THRING & Co., Scholastic Agents, 36 Sackville Street, London, W.

SCIENCE EXAMINATIONS.

For LONDON and other UNIVERSITIES, the
CONJOINT BOARD, &c.

Well-equipped LABORATORIES, DAY AND EVENING. Personal or Class Tuition.
"R." 9 Heathcote Street, Gray's Inn Road, W.C.

BOTANIST (28), B.Sc. (Lond.), Ph.D.
(Goett.), seeks position as LECTURER or DEMONSTRATOR; or RESEARCH, preferably Veg. Physiology, incl. Bacteriology; or Literary Work (trans.); Knowledge of Chemistry.—"Z," NATURE Office.

EXPERIMENTAL WORKS, BATH.—

Facilities for conducting Scientific and Mechanical Investigations. Pupil taken. Seventy acres of ground.—Apply to MANAGER.

BECK'S MICROSCOPE, International

Stand, with quantity Fittings, condition as new. Cost over £90, to be sold for half. On View.—Apply, "Ark," 742 Holloway Road, N.

BARGAINS IN SCIENTIFIC BOOKS.

CAMPBELL (D. H.), THE STRUCTURE AND DEVELOPMENT OF THE MOSSES AND FERNS (ARCHÉGONIATÆ), by DOUGLAS HOUGHTON CAMPBELL, Ph.D., fully Illustrated, Medium 8vo (pub. 14s. net), 4s.

Gardeners' Chronicle.—"Dr. Campbell's book is clearly written, well illustrated, is provided with an accurate bibliography and a copious index, so that it will take its place at once as a standard classic, and will, we think, retain that position for no inconsiderable period."

DAVIS (George E.), PRACTICAL MICROSCOPY, Illustrated with 310 Woodcuts and a Coloured Frontispiece, Third and Revised Edition, 8vo, Cloth (pub. 7s. 6d.), 3s.

This is the third and enlarged edition, bringing down the subject to the present time; and not only has this been done with regard to English instruments, but the scope of the work has been extended so as to include the apparatus in general use upon the Continent and also in the United States.

MEYRICK (E.), A HANDBOOK OF BRITISH LEPIDOPTERA, by EDWARD MEYRICK, B.A., F.Z.S., F.E.S., Assistant Master at Marlborough College. Extra Crown 8vo (pub. 10s. 6d. net), 3s.

"This book cannot fail to afford great assistance to the student who desires to recognise and identify his specimens without the necessity of comparing them with named examples. It is without exception the best class-book that has yet appeared for imparting real sound knowledge of structure, evolution, and classification."—*Entomologist's Monthly Magazine*.

Postage extra.

H. J. GLAISHER, New and Remainder Bookseller, 57 Wignmore Street, London, W.

Catalogues Post Free on application.

NOW READY.

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY.

CONTENTS OF SERIES B (VOL. 191).

Price £1 12s. (with *Thirty-one Plates*).

On Artificial Temporary Colour-Blindness, with an Examination of the Colour Sensations of 109 Persons. By George J. BURCH.

Contributions to our Knowledge of the Formation, Storage and Depletion of Carbohydrates in Monocotyledons. By JOHN PARKIN.

On the Structure and Affinities of Fossil Plants from the Paleozoic Rocks—III. On *Medullosa anglica*, a New Representative of the Cycadofilices. By D. H. SCOTT.

A Study of the Phenomena and Causation of Heat Contraction of Skeletal Muscle. By T. G. BRODIE and S. W. F. RICHARDSON.

A Soil Bacillus of the Type of De Bary's *B. Megatherium*. By W. C. STURGIS.

On the Structure and Affinities of *Matonia pectinata*, R.Br., with Notes on the Geological History of the Matonineæ. By A. C. SEWARD.

The Physiological Action of Choline and Neurine. By F. W. MOTT and W. D. HALLIBURTON.

Onygena equina, Willd., a horn-destroying fungus. By H. MARSHALL WARD.

Observations on the Anatomy, Physiology and Degenerations of the Nervous System of the Bird. By ROBERT BOYCE and W. B. WARRINGTON.

London: HARRISON & SONS, 45 St. Martin's Lane, W.C.

WEBSTER'S INTERNATIONAL DICTIONARY OF THE ENGLISH LANGUAGE.

One Volume, Cloth, £1 11s. 6d.

A PRACTICAL, HANDSOME AND CHEAP XMAS PRESENT FOR THE MAN OF SCIENCE AND THE MAN OF AFFAIRS.

It excels in the ease with which the eye finds the word sought; in accuracy of definition; in effective methods of indicating pronunciation; and in terse and comprehensive statements of fact.

WEBSTER'S DICTIONARY has been so long and so well known that it seems superfluous to say much as to its great merits and practical usefulness. In order that the book may continue to deserve its success every pains have been taken to keep it thoroughly abreast with modern scholarship.

In the year 1891 was issued the Third Edition, which can fairly claim to be practically a new book. This edition was reprinted with corrections in 1892 and 1894, and was revised in 1897. Its vast superiority over former editions is attested by the following facts:—

The whole work has been reset in new type from beginning to end. The preceding edition, with all its supplementary matter, has been re-studied **line by line**.

A close comparison has been made with a whole library of the most recent works on **philology** and all branches of knowledge that include new usages of speech.

Upon **technical** subjects specialists have been employed, and their contributions have been carefully harmonised in form with the general principles of the revision.

Great care has been devoted to the **illustrations**; the number has been increased from **3000** to nearly **4000**, and about two-thirds of them are entirely new.

THE ATHENEUM.—"... The publication of this volume of 2118 pages ought to be regarded with gratitude as a remarkable and beneficent achievement."

This Dictionary is issued in one or two volumes, bound in various styles, at prices ranging from **£1 11s 6d.** to **£3 15s.** The Half-Calf Binding, price **£2 2s.**, is strongly recommended.

On receipt of a Postcard mentioning **NATURE**, a detailed Prospectus will be sent Post free.

LONDON: GEORGE BELL & SONS, YORK STREET, COVENT GARDEN.

STEVENS'S AUCTION ROOMS, 38 KING STREET, COVENT GARDEN.

SALE ANNOUNCEMENTS.

MONDAY, DECEMBER 4.—A Collection of Benin Relics and Bronzes, Japanese Art Work, Curiosities from German East Africa, Antiquities, Carvings, Ancient Implements, &c.

MONDAY, DECEMBER 11.—A Special Sale of Expensive Lanterns and Accessories, Hand-painted and other Slides, &c.

TUESDAY, DECEMBER 12.—Magnificent Carvings from New Zealand, a fine Collection of New Zealand Curios, Curiosities from South Pacific, Africa, &c.

On view mornings of Sale, and Catalogues had Post free on application.

ADAM HILGER, Astronomical and Optical Instrument Works, 204 STANHOPE STREET, N.W.

Maker of Scientific Instruments to the Royal College of Science, H.M. Government, Council of India, all the Principal Universities and Observatories of Great Britain, and by Special Appointment to the Royal Institution.

Mr. HILGER has now a large Stock of ICELAND SPAR PRISMS on hand, accurately cut to give single refraction.

Lenses of Quartz corrected by Iceland Spar, for Visual Work or Spectro-photography. These are made from curves selected by J. W. GIFFORD, Esq., for either achromatism or best applanatism in the ultra-violet.

Experimental Instruments are carried out to design on the shortest notice.

Telegraphic Address—"SPHERICITY, LONDON."

PATENTS.

JAMES G. LORRAIN, M.I.E.E., M.I.MECH.E., &c.,

CHARTERED PATENT AGENT,

Norfolk House, Norfolk Street, LONDON, W.C.

Speciality—PHYSICAL PATENTS,

OPPOSITIONS, AND AMENDMENTS.

Charges on Application.

Telephone No. 2511 GERRARD.

Telegrams: "LORRAIN, LONDON."

"Patentees' Handbook" Post free on application.

T. TAMBLYN-WATTS, SCIENTIFIC APPARATUS MAKER.

Catalogue of Electrical Apparatus and Materials, 6d. Post free.

Catalogue of Balances and Weights, Apparatus for the Study of Mechanics, &c., 6d. Post free.

GOLDIELANDS, SETTLE, YORKS.

SCIENCE GOSSIP.

ESTABLISHED 1865.

AN ILLUSTRATED MONTHLY RECORD OF NATURE, COUNTRY LORE, PHYSICAL AND APPLIED SCIENCE.

Edited by JOHN T. CARRINGTON, assisted by F. WINSTON.

SELECTION OF CONTENTS FROM DECEMBER NUMBER.

An Introduction to British Spiders,* by Frank P. Smith. Opium, its Source, Varieties, and Composition, by Lewis Ough. A History of Chalk* (continued), by Edward A. Martin, F.G.S. A History of Radiography* (continued), by James Quick. Departmental Snubbing of Science. Butterflies of the Palaearctic Region* (continued), by Dr. H. C. Lang. British Fresh-water Mites,* by C. D. Soar, F.R.M.S. Book Reviews. Microscopy.* Physics. Astronomy.* Botany. Geology. Mollusca. Notes. Correspondence. Chapters for Beginners.*

* Illustrated.

SIXPENCE MONTHLY.

Send Sixpence in stamps for specimen copy, Post free.

Subscription, 6s. 6d. per annum, Post free throughout the world; or it may be ordered through any Bookseller.

NEW OFFICE: 110 STRAND, LONDON, W.C.

LAMLEY & CO.

JUST PUBLISHED.

PRIMEVAL SCENES.

Being some Comic Aspects of Life in Prehistoric Times.

By the Rev. H. N. HUTCHINSON,

Author of "Extinct Monsters." Imp. 4to, 6s.

Twenty-five full-page Drawings and an original Cover Design by J. HASSALL and F. V. BURRIDGE, illustrating some comic aspects of life in prehistoric times, with a few lines of explanatory text to each picture.

The Author has taken great pains to show the public that "Prehistoric Peeps" may be amusing, and at the same time drawn strictly in accordance with scientific discovery.

LAMLEY & CO., 1 and 3 EXHIBITION ROAD, S.W.

PHYSICAL AND MECHANICAL APPARATUS.

EVERETT & CO.,

Engineers and Electricians,

22 CHARTERHOUSE SQUARE, LONDON, E.C.

Scientific and Electrical Instrument Makers.

Apparatus for Laboratories, &c., designed and made to meet any requirements.

MACHINES FOR ANY SPECIAL PURPOSE BUILT TO ORDER.

MODELS DESIGNED AND MADE FOR INVENTORS.

Accuracy combined with Highest Skill at Reasonable Charges.

REPAIRS OF EVERY DESCRIPTION.

OPTICAL & SCIENTIFIC INSTRUMENTS.

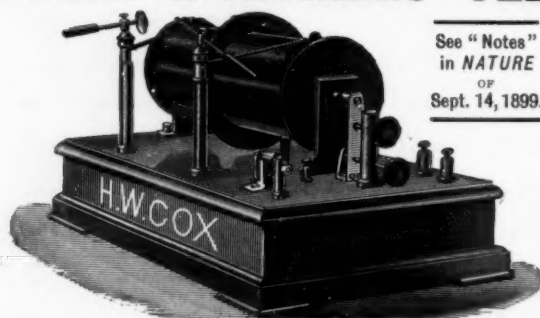
Spectrometers, Spectroscopes, Goniometers, Cathetometers, Optical Benches, &c., &c. Instruments for special purposes constructed to Clients' own designs. Price List on application.

W. WILSON (formerly Foreman at Messrs. ELLIOTT BROS.),

1 Belmont Street, Chalk Farm Road, London, N.W.

CONTRACTOR TO H.M. GOVERNMENT.

X-RAY & ÆTHERIC TELEGRAPHY APPARATUS



See "Notes"
in NATURE
OF
Sept. 14, 1899.

OF THE HIGHEST QUALITY AND FINISH ONLY.

As supplied by us to H.M. Government and the leading Hospitals and X-Ray Workers throughout the World.

We are the actual Manufacturers, and Guarantee every Coil against breaking down.

CALL OR WRITE FOR OUR NEW ILLUSTRATED LIST, WITH TESTIMONIALS AND ILLUSTRATED INSTRUCTIONS UPON HOW TO WORK. POST FREE TO READERS OF "NATURE."

HARRY W. COX, Ltd.,

10, 11, 28 CURSITOR STREET,

CHANCERY LANE, LONDON.

Radiographs taken for Scientific and Medical Men, and Demonstrations given.

THE GREATEST AND MOST SCHOLARLY WORK ON THE HISTORY OF THE ANCIENT WORLD.

PROFESSOR MASPERO'S HISTORY OF THE ANCIENT PEOPLES OF THE CLASSIC EAST

IS NOW COMPLETE, EMBRACING THREE VOLUMES UNDER THE FOLLOWING TITLES:

THE DAWN OF CIVILIZATION (EGYPT and CHALDÆA). New and Revised

Edition. By Professor MASPERO. Edited by the Rev. Professor SAYCE. Translated by M. L. McCLURE. With Map and over 470 Illustrations, including 3 Coloured Plates. Demy 4to (approximately). Cloth, bevelled boards, 24s.; half-morocco (bound by Riviere), 48s.

Professor Maspero, by using the result of the most recent researches in Egypt and Mesopotamia, has brought this new edition up to the latest date.

THE STRUGGLE OF THE NATIONS: EGYPT, SYRIA, and ASSYRIA. By

Professor MASPERO. Edited by the Rev. Professor SAYCE. Translated by M. L. McCLURE. With Maps, 3 Coloured Plates, and over 400 Illustrations. Demy 4to (approximately). Cloth, bevelled boards, 25s.; half-morocco (bound by Riviere), 50s.

"The translation by M. L. McCLURE is in both cases excellent. Professor Maspero's presentation of the new learning is at once eminently popular and attractive."—*Times*.

"The author has throughout attempted to reproduce for us the daily life of the various peoples of whom he treats, and in this he has succeeded admirably."—*Academy*.

THE PASSING OF THE EMPIRES 850 B.C. to 330 B.C. By Professor MASPERO.

Edited by the Rev. Professor SAYCE. Translated by M. L. McCLURE. With Maps, 3 Coloured Plates, and numerous Illustrations. Demy 4to (approximately). Cloth, bevelled boards, 25s.; half-morocco (bound by Riviere), 50s.

[This volume brings down the history of Egypt, Assyria, Babylonia, Persia, Media, &c., to the Conquests of Alexander the Great. Among other things of interest to Bible Students it deals with the circumstances attending the Captivities of Israel and Judah, and throws much light on the historic references in the Prophets.]

This monumental work is and must remain for some time to come the most comprehensive and trustworthy account of the ancient Eastern world.

MATTER, ETHER AND MOTION. The

Factors and Relations of Physical Science. By A. E. DOLBEAR, Ph.D., Professor of Physics, Tuft's College, U.S.A. English Edition edited by Professor ALFRED LODGE. Illustrated. Crown 8vo, cloth boards, 5s.

"Every page shows that the author is alive to the far-reaching consequences and implications of modern science. Professor Dolbear's pages are eminently readable, and his presentation of the philosophy of modern physics is lucid, interesting, exhaustive, and for the most part convincing."—*Literature*, Nov. 4, 1899.

THE ROMANCE OF SCIENCE.—OUR

SECRET FRIENDS AND FOES. By PERCY FARADAY FRANKLAND, Ph.D., B.Sc. (Lond.), F.R.S. Fourth Edition, Revised and Enlarged, with several Illustrations. Small post 8vo, cloth boards, 3s.

* * * Eleven other Volumes have already appeared in this Series. List on application.

BRITISH BIRDS, SKETCH BOOK OF.

By R. BOWDLER SHARPE, LL.D., F.L.S. 272 pp., crown 4to. With Coloured Illustrations by A. F. and C. LYDON. Cloth boards, 14s.

"Briefly he has produced a most interesting and informing book, which has been admirably illustrated."—*Guardian*.

A CHAPTER ON BIRDS—RARE BRITISH

VISITORS. By R. BOWDLER SHARPE, LL.D., F.L.S. With eighteen beautifully Coloured Plates. Crown 8vo, cloth boards, 2s. 6d.

"The book is teeming with interesting facts, and should be added to every bird-lover's library, as an inexpensive but thoroughly reliable work."—*Knowledge*.

THE HISTORY OF INDIA. From the

Earliest Times to the Present Day. By Captain L. J. TROTTER. Revised Edition, brought up to date. With Map and numerous Illustrations. Demy 8vo, cloth boards, 6s.

HISTORICAL CHURCH ATLAS. Illus-

trating the History of Eastern and Western Christendom until the Reformation, and that of the Anglican Communion until the present day. By EDMUND McCCLURE, M.A. Containing 18 Coloured Maps, besides some 50 Sketch Maps in the Text. 4to, cloth boards, leather back, 16s.

"Both the readers of ancient Church history and of modern missionary records will find abundant materials in it for their assistance."—*Guardian*.

"A great deal of labour and sound scholarship has gone to the making of this Atlas."—*Academy*.

STAR ATLAS. Gives all the Stars from

1 to 6th Magnitude between the North Pole and 34° South Declination, and all Nebulae and Star Clusters which are visible in telescopes of moderate powers. Translated and adapted from the German of Dr. KLEIN, by the Rev. E. McCCLURE, M.A. Imperial 4to, with 18 Charts and 80 pages Illustrative Letterpress. Cloth boards, 7s. 6d.

THE ANCIENT HEBREW TRADITION

AS ILLUSTRATED BY THE MONUMENTS. A Protest against the Modern School of Old Testament Criticism. By Dr. FRITZ HOMMEL, Professor of Semitic Languages in the University of Munich. Translated from the German by EDMUND McCCLURE, M.A., and LEONARD CROSSLE. With Map. Large Post 8vo, buckram boards, 5s.

"Under the weight of Dr. Hommel's cumulative evidence the latest fortress of the 'Higher Criticism' will have to be promptly evacuated or surrendered at discretion. The book has been admirably translated by Mr. McCCLURE and his coadjutor."—*Daily Chronicle*.

"As a protest against the modern school of Old Testament criticism we cordially commend the work as one of the most valuable yet published."—*Pall Mall Gazette*.

ANCIENT HISTORY from the MONU-

MENTS.—ASSYRIA, from the Earliest Times to the Fall of Nineveh. By the late GEORGE SMITH, of the British Museum. New and Revised Edition by the Rev. Prof. SAYCE. Fcap. 8vo, cloth boards, 2s.

ANCIENT HISTORY from the MONU-

MENTS.—THE HISTORY OF BABYLONIA. By the late GEORGE SMITH. Edited and brought up to date by the Rev. Prof. SAYCE. Fcap. 8vo, cloth boards, 2s.

NON-CHRISTIAN RELIGIOUS

SYSTEMS: BUDDHISM. Being a Sketch of the Life and Teachings of Gautama, the Buddha. By T. W. RHYS DAVIDS, Ph.D., LL.D. New and Revised Edition, with Map. Fcap. 8vo, cloth boards, 2s. 6d.

THE HOLY GOSPELS. With Illus-

trations from the Old Masters of the XIVth, XVth and XVIth Centuries. More than three hundred works dealing exclusively with the events of our Lord's life have been chosen from among the greatest examples of the Italian, German, Flemish, and French Schools for the subject of these Illustrations. These pictures, distributed as they are amongst the Churches and Galleries of the civilised world, are here, for the first time, collected together and presented in proximity to the sacred narrative which they were intended to illustrate. Notes dealing with the pictures from the artistic standpoint are contributed by M. EUGÈNE MUNTZ, member of the French Institute. The publication includes also a chronological and biographical table of the painters whose works are reproduced, and a classified list of the engravings. The work contains 384 pages (Imperial 4to) and nearly 350 Illustrations, 48 of these being separate Plates printed in two tints. Half-bound, paste grain roan, 47s. 6d.; whole bound, paste grain roan, 56s.

SOCIETY FOR PROMOTING CHRISTIAN KNOWLEDGE,

LONDON: NORTHUMBERLAND AVENUE, W.C.; 43 QUEEN VICTORIA STREET, E.C.
BRIGHTON: 129 NORTH STREET.

FOURTH EDITION NOW READY.

Crown 8vo, Cloth, price 7s. 6d.

PROPERTIES OF MATTER.

By PROF. P. G. TAIT, M.A., Sec.R.S.E.,

Professor of Natural Philosophy in the University of Edinburgh.
Author of "Light," "Dynamics," &c.

NOW READY. Crown 8vo, Cloth, price 1s. 6d. net.

NEWTON'S LAWS OF MOTION.

By PROF. P. G. TAIT.

"Thoroughly deserves to be read; it shows us how a veteran physicist regards the foundations of his science, and this is worth more than many immaculate but spiritless compendia."—*School World*.From *Literature*.—"It is something more than a text-book, and its author's name is a guarantee of its value."

With 9 Plates.

Demy 8vo, Paper Boards, price 7s. 6d. net.

MICROSCOPIC RESEARCHES ON GLYCOGEN.

PART II. GLYCOGEN OF SNAILS AND SLUGS IN MORPHOLOGICAL AND PHYSIOLOGICAL CORRESPONDENCE WITH THE LYMPH SYSTEM OF VERTEBRATES.

By C. CREIGHTON, M.D.

NOW READY. PRICE 16s. net.

Cheap Issue in one handy volume, Demy 8vo, Cloth, 1232 pages.

A DICTIONARY OF BIRDS.

By ALFRED NEWTON, M.A., F.R.S.,

Professor of Zoology and Comparative Anatomy in the University of Cambridge.

Containing 340 Illustrations and a Map.

"The most comprehensive review of the subject of ornithology extant, and in it will be found a concise summary on most of the important works of ornithology from the earliest times."—*Nature*.

In Demy 8vo, Boards, price 3s. 6d. net.

A CLASSIFICATION OF VERTEBRATA,**RECENT AND EXTINCT.**

By HANS GADOW, M.A., Ph.D., F.R.S.,

Strickland Curator and Lecturer on Zoology to the University, Cambridge.

"It is a book—it need hardly be said—for the student; it is simply a list of the principal sub-divisions of back-boned animals, with just as much definition as is needed. It may be regarded as an exceedingly concentrated extract of a full text-book of the vertebrates."—*The Daily Chronicle*.

Demy 8vo, Cloth, price 18s. net.

ZOOLOGY OF THE INVERTEBRATA.

A Text-Book for Students.

By A. E. SHIPLEY, M.A.,

Fellow and Assistant Tutor of Christ's College, and Demonstrator of Comparative Anatomy in the University of Cambridge.

Illustrated with 263 Figures.

"In classification, Mr. Shipley is convincing and ingenious. The book is well illustrated, well indexed, and conveniently arranged."—*Natural Science*.

A. & C. BLACK, SOHO SQUARE, LONDON, W.

THE BRIDGES-LEE PHOTO-THEODOLITE*The most perfect instrument invented for Survey Work in Mountainous Districts, and for Military or Rapid Surveys.*

The Photo-Theodolite automatically records on the photograph all, or nearly all, the data necessary for the reduction of the photographs, including the Magnetic bearings, — thus considerably reducing the time spent and the risk of error in the interpretation of the photographs.

The Instrument is fitted with an Aluminium Body, 6-in. Azimuthal Circle, reading with Vernier to one minute of arc, 4-in. Compass, divided to half degrees. Telescope with erect and inverting Eye-pieces, rapid Rectilinear Lens with Iris Diaphragm and Colour Screen, six double dark Slides in Mahogany Case, with Stand complete, £45.

Descriptive Pamphlets and Illustrated Description of the Instrument sent free on application.

AGENT FOR RICHARD FRÈRES' AUTOMATIC RECORDING INSTRUMENTS.

L. CASELLA,**147 Holborn Bars, London, E.C.**

Telegraphic Address: "Escutcheon, London." Telephone: Holborn 1054.

QUARTZ FIBRES.

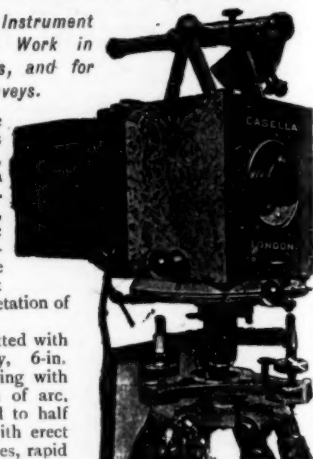
We are now making **QUARTZ FIBRES** about 40 cm. long, capable of supporting a weight of 50 grammes. These are especially suitable for suspending heavy magnets.

Price of Box containing 6 of these Fibres,
£1 0 0

FIBRES SUITABLE FOR GALVANOMETER SUSPENSIONS.

		s.	d.
In Box containing 6 Fibres	16 cm. long	5	0
"	" " 30 "	7	6
"	" " 40 "	10	0

SCIENTIFIC INSTRUMENT CO.
LIMITED,
CAMBRIDGE.

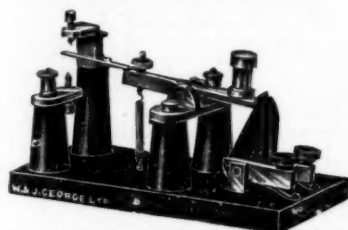


"NIVOC" SPECIALITIES.

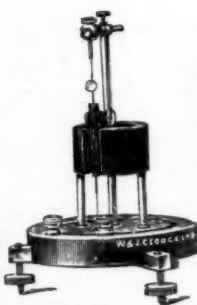
WORKS—BIRMINGHAM.

Buy direct from the Manufacturers.

THESE INSTRUMENTS ARE SPECIALLY
SUITED FOR WORKING TOGETHER.



KEMPE'S CHARGING & DISCHARGING KEY.
Improved Form with rubbing contacts, highly
insulated, £3 15s. Highest quality and finish.
Late F. E. BECKER & CO.)



"NIVOC" MOVING COIL GALVANOMETER
BALLISTIC, very sensitive. To work with $\frac{1}{2}$ Micro-
Farad Condenser, £2 10s.



STANDARD CONDENSER, $\frac{1}{2}$ Micro-
Farad, £2 12s. 6d.

STANDARD CLARK CELL, 25s. net.

W. & J. GEORGE, LTD., 33-37 HATTON WALL, LONDON.

NEW SCIENCE LANTERN.



The Universal Science Lantern has been devised for the projection of experiments. In the short box in front of the lantern is a hinged mirror, so placed that by the movement of a stud it may be introduced and placed at an angle of 45 degrees with the parallel beam. The beam is thus sent upwards through a horizontal convergent lens, on which a slide or horizontal piece of apparatus can be placed. Above this is the objective mounted on a brass pillar, and above the objective a prism or mirror (if the screen is elevated above the lantern plain prisms are required for each beam), silvered on the outside so that there is no double reflection. The mirror can be adjusted to any angle, and is intended to send the image in an approximately horizontal direction to the screen. Slides can also be directly projected in the usual way.

The base-board is made to fold so that the lantern can be packed into a box 18 $\frac{1}{2}$ x 24 x 20 $\frac{1}{2}$ with all its accessories *in situ*.

Price Complete, in Travelling Box, £9 0 0

REYNOLDS & BRANSON, LTD.
14 COMMERCIAL STREET, LEEDS.

ISENTHAL, POTZLER & CO.,

85 MORTIMER STREET, LONDON, W.

Telegrams: "HYSTERESIS."

Telephone: 2099, GERRARD.

CENTRAL DEPOT FOR RADIOGRAPHERS.



INDUCTION COILS OF HIGH EFFICIENCY.

Write for Lists, or better inspect our Installations.
HIGHEST REFERENCES.

EVERYTHING NOVEL & ORIGINAL.


Sole Agents for Scotland:

Messrs. JAMES WHITE, Cambridge Street, Glasgow.

WATKINS & DONCASTER,

NATURALISTS,
AND MANUFACTURERS OF
CABINETS AND APPARATUS
FOR ENTOMOLOGY, BIRDS' EGGS, AND ALL BRANCHES OF
NATURAL HISTORY.

SPECIAL SHOW-ROOM FOR CABINETS.

 Call or send for detailed Catalogue (86 pp.), Post free on application.

N.B.—For Excellence and Superiority of Cabinets and Apparatus, references are permitted to distinguished patrons, Museums, Colleges, &c.

A LARGE STOCK OF INSECTS AND BIRDS' EGGS.

Birds, Mammals, &c., Preserved and Mounted by First-class Workmen with true natural surroundings. All Books and Publications on Natural History supplied.

36 STRAND, LONDON. W.C.
(Five Doors from Charing Cross.)

MINERALS, ROCKS & FOSSILS.

COLLECTIONS FOR STUDENTS.

Carefully labelled and arranged in Boxes with Card Trays.
50 Minerals, 12/6; 100 do., 21/-; 200 do., 42/-.
Rocks and Fossils at similar prices.
300 Minerals in Cabinet, £4 4s.; 400 do., £5 12s. 6d.
Catalogues Post Free.

THOMAS D. RUSSELL,
78 NEWGATE STREET, LONDON, E.C.

PHYSIOGRAPHY and GEOLOGY.

COLLECTIONS & MICROSCOPIC SLIDES,

As advised by Science and Art Directory, arranged by
JAMES R. GREGORY & CO.,
Mineralogists, &c.,

To Science and Art Department, British, Indian and Colonial
Museums, &c.

NOVELTIES and RARE GEMS and PRECIOUS STONES.

Mineral Specimens for Museums, and Collectors, and all purposes.
Rock Specimens and Microscopic Sections of Rocks and Minerals
cut to order.

NEW AND VALUABLE MINERAL SPECIMENS CONSTANTLY
ARRIVING.
Stores & Offices: 1 Kelso Place, KENSINGTON, W.
NEW CATALOGUES AND LISTS FREE.

MINERALOGY.

Micro. Slides, Collections and Single Specimens of Minerals, Rocks and Precious Stones, for the Student, Teacher and Prospector.
Elementary Collections in Case, 40 Specimens in Case, 6s. Blowpipe Cases and all necessities for Field or Class Work.

LESSONS GIVEN.

SAMUEL HENSON,
97 REGENT STREET, LONDON, W.
ESTABLISHED 1840.

TO SCIENCE LECTURERS.
HUGHES' MOTO-PHOTOGRAPH FOR LIVING PICTURES.
THE MOST PERFECT.

No SHUTTER, therefore no Flickering. Superb Mechanism.
The Moto-Photo Camera for taking the Pictures. Illustrated Lists, ad. See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN, &c. Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great success. New Oxyhydrogen Microscope. Science Lanterns for Class Demonstration. Magnificent Results. Docwra Triple, Prize Medal, Highest Award. Supplied to the Royal Polytechnic Institution, Dr. H. GRANT GUINNESS, Madame ADELINA PATTI, &c., &c. Patent Pamphengos Science Lanterns. The Universal Lantern 4-inch Condensers, 4-wick Lamp, Portrait Combination front Lenses, 18s. 6d., Marvellous value. Science Lecture Sets. Novelities. The Lantern Kaleidoscope. Cheapest Lantern Outfits in the World. Grandly Illustrated Catalogue, over 180 choice Engravings, 6d.; Postage, 3d. List of 300 Lecture Sets, Science Subjects, Views, &c., 6d.; Postage, 3d. Pamphlets Free. W. C. HUGHES, SPECIALIST, Brewster House, 82 Mortimer Road, Kingsland, N.

CO-OPERATIVE WORLD TRAVEL

Organised by HENRY S. LUNN, M.D., F.R.G.S.,
W. HOLDSWORTH LUNN, & CONNOP F. S. PEROWNE.

A Cruise to the WESTERN MEDITERRANEAN.

TILBURY, GIBRALTAR, TANGIER, ALGIERS, PALMA, VILLE-
FRANCHE (for NICE, CANNES, MONTE-CARLO), MARSEILLES.

A FIFTEEN DAYS' CRUISE FOR £9 9s. AND UPWARDS.

A Cruise to the EASTERN MEDITERRANEAN.

(Return ticket to MARSEILLES included.)

MARSEILLES, SYRACUSE, PIRÆUS (for Athens),
CONSTANTINOPLE, JAFFA (for Jerusalem), ALEXANDRIA,
MALTA, NAPLES, MARSEILLES.

A THIRTY-FIVE DAYS' CRUISE FOR £36 15s. AND UPWARDS
s.v. ARGONAUT. Tonnage, 3254; h.-p., 4000.

Full particulars from the Secretary, 5 Endsleigh Gardens,
Euston, London, N.W.

LIVING SPECIMENS FOR THE MICROSCOPE.

Volvox, Spirogyra, Desmids, Diatoms, Amœba, Arcella, Actinosphaerium,
Vorticella, Stentor, Hydra, Floscularia, Stephanoceros, Melicerta, and many
other Specimens of Pond Life. Price 1s. per Tube. Post Free. Helix
pomatia, Astacus, Amphioxus, Rana, Anodon, &c., for Dissection purposes.

THOMAS BOLTON,

25 BALSALL HEATH ROAD, BIRMINGHAM.

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM. THE LABORATORY, PLYMOUTH.

The following animals can always be supplied, either living
or preserved by the best methods:—

Sycon; Clava, Obelia, Sertularia; Actinia, Tealia, Caryophyllia, Alcy-
onium, Hormiphora (preserved); Leptopiana; Lineus, Amphiporus; Nereis,
Aphrodite, Arenicola, Lanice, Terebella; Lepas, Balanus, Gammarus,
Ligia, Mysis, Nebalia, Carcinus; Patella, Buccinum, Eledone, Pecten
Bacula, Crisia, Pedicellina, Holothuria, Asterias, Echinus; Ascidia, Salpa
(preserved), Scyllium, Raja, &c., &c.
For prices and more detailed lists apply to
Biological Laboratory, Plymouth.

THE DIRECTOR.

ALBERT EDWARD JAMRACH (Late CHARLES JAMRACH), NATURALIST,

180 ST. GEORGE STREET EAST.

Implements of Savage Warfare, Idols, Sacred Masks, Peruvian Pottery,
Netsukis China, Lacquers, Gongs, Shells, and other Curios.

PHENIX FIRE OFFICE, 19 LOMBARD ST., E.C., and 57 CHARING CROSS, S.W. ESTABLISHED 1782.

MODERATE RATES. ABSOLUTE SECURITY.

ELECTRIC LIGHTING RULES SUPPLIED.

LIBERAL LOSS SETTLEMENTS.

PROMPT PAYMENT OF CLAIMS.

FRANCIS B. MACDONALD, SECRETARY.

LOSSES PAID OVER £22,000,000.

ESTABLISHED 1851.

BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

INVESTED FUNDS

£10,000,000.

The BIRKBECK ALMANACK, with full particulars, post free.

FRANCIS RAVENSCROFT, Manager.

THE IRISH NATURALIST.

A Monthly Magazine of Irish Zoology, Botany, and
Geology. Price 6d.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD

PRAEGER, B.A.

Annual Subscription, 5s. Post Free to any Address.

Dublin: EASON & SON, LTD., 40 Lower Sackville Street

(to which Address Subscriptions should be sent).

London: SIMPKIN, MARSHALL, HAMILTON, KENT, & CO., Ltd.

A HANDSOME PRESENT FOR COUNTRY HOUSES.

NATURE RE-ISSUE

OF

SOWERBY'S ENGLISH BOTANY.

THIRD EDITION, WITH SUPPLEMENT.

CONTAINING A DESCRIPTION AND HAND-COLOURED

LIFE-SIZE DRAWING OF EVERY BRITISH PLANT.

The Proprietors of *NATURE* feel themselves peculiarly fortunate in having been able to offer to the public, **though for a limited time only**, these special terms for a recognised authority on descriptive English Botany, of nearly a hundred years standing, which no naturalist, collector, or lover of flowers can afford to neglect. For identification and classification the student will find its **careful descriptions, accurate plates, and copious indices** invaluable; while those who haunt our country lanes and wander along our field-paths for mere pleasure of the eye will be filled, in turning over its beautiful pages, with yet fresh cause for wondering delight at the beauty of many of the humblest flowering weeds we are but too apt to tread on with a careless step.

"Nothing can exceed the beauty and accuracy of the coloured figures. They are drawn life-size—an advantage which every young amateur will recognise who has vainly puzzled over drawings in which a celandine is as big as a poppy—they are enriched with delicate delineations of fruit, petal, anther, and any organ which happens to be remarkable in its form. . . . A clear, bold, distinctive type enables the reader to take in at a glance the arrangement and divisions of every page. And Mrs. Lankester has added to the technical description by the editor an extremely interesting popular sketch, which follows in smaller type. The English, French, and German popular names are given, and, wherever that delicate and difficult step is at all practicable, their derivation also. Medical properties, superstitions and fancies, and poetic tributes and allusions, follow. In short, *there is nothing more left to be desired.*"—*THE GUARDIAN*.

TEMPORARY PRICES OF THE THIRTEEN VOLUMES
FOR THIS YEAR ONLY.

	CASH.	MONTHLY INSTALMENTS.	PUBLISHERS' PRICE.
CLOTH BINDING ...	£16	£16 16s.	£25.

HALF-MOROCCO SETS ALL SOLD.

Copies of the book may be seen at *NATURE* Office, St. Martin's Street, W.C. An explanatory pamphlet, giving specimen pages, full contents, extracts from the preface, with a sample illustration and Order Form, will be sent Post free on application to

C. Worsfold, *NATURE* Office, St. Martin's Street, London, W.C.

CHRISTMAS ORDERS MAY BE MARKED

"FOR DELIVERY BETWEEN DECEMBER 20 & 25."

ORDER FORM FOR MONTHLY PAYMENTS.

Date..... 1899.

All cheques should be crossed and made payable to C. Worsfold, *NATURE* Office, St. Martin's Street, W.C.

I enclose One Guinea as first payment for a copy of "*Sowerby's English Botany*" bound in Cloth, Sixteen Guineas, and I agree to pay to you, or to your representative, the balance at the rate of One Guinea per month; my next payment to be on the delivery of the volumes, and my remaining payments on the corresponding day of each month following.

Until such payments are complete, I engage that the Work, not being my property, shall not be disposed of by sale or otherwise.

I further agree that if it be found impossible for any reason to deliver the book, the return of the sum of One Guinea to me shall cancel this agreement.

Name

Address

Residents abroad are kindly requested to remit in full, or to instruct their representatives in England to make the monthly payments, in order to avoid expense and delay in forwarding cash from abroad.



CARL ZEISS, OPTICAL WORKS, JENA.

London Branch :
29, MARGARET STREET, REGENT
STREET, W.

MICROSCOPES and ACCESSORIES
—For Bacteriology, Biology, Mineralogy and
Student's use. — Apochromatic, Achromatic
Objectives. — Micrometers, &c.

OPTICAL MEASURING INSTRUMENTS. — Spherometers, New Crystal Refractometer, Butter-Refractometer for the rapid determination of the purity of Butter, Lard, and Glycerine.

NOTE. — We do not make Theodolites.

Illustrated Catalogues, including new edition (1898) of Catalogue of Microscopes, free. Please state which required.

MOORE'S HYDROSTATIC BALANCE



FOR ILLUSTRATING THE "PRINCIPLE OF ARCHIMEDES" AND SPECIFIC GRAVITY.

A is a delicate spring balance accurately graduated to read Grams, and is capable of being lowered or raised by the string shown.

B is one of the set of cubes of various metals supplied with the apparatus.

C is a glass vessel with fixed mark etched in glass, up to which water, or other liquid, is placed. The vessel is provided with draw-off cock.

Sole Makers of this Apparatus—

BREWSTER, SMITH, & CO.,
6 CROSS STREET, FINSBURY, E.C.

Manufacturers and Importers of Chemical and Scientific Apparatus and Pure Chemicals.

WEIGHTS a Speciality, 500 Milligrams to 1 Milligram, 1s. 6d. per doz.

SEND FOR COMPLETE ILLUSTRATED CATALOGUE.



Apparatus for estimation of sulphur in spent oxide.

FREDK. JACKSON & Co.

(Late MOTTERSHED & CO.),
14 CROSS STREET, MANCHESTER.

Goods Entrance: 10 Half-Moon Street,

LABORATORY FURNISHERS,
Importers, Manufacturers, and Dealers in
CHEMICAL AND PHYSICAL APPARATUS

Of every Description.

Fine Chemicals, Volumetric Solutions,
Plain and Stoppered Bottles,

AND EVERY LABORATORY REQUIREMENT.

Illustrated Catalogue of Apparatus, with Price List of Chemicals, free on application.

Telegraphic Address—"APPARATUS, MANCHESTER."

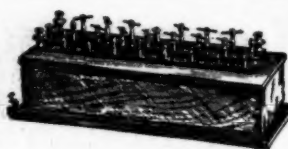
Telephone Number—2038.

W. G. PYE & CO.

Physical & Physiological Instrument Makers,
30 ST. ANDREW'S STREET, CAMBRIDGE.

STUDENTS'
BRIDGE

Aggregate
Guaranteed
Platinoid



WHEATSTONE
BOX.

12,220 ohms
to 1 in 500.
Wire.

Price £9 10s., as illustrated. Smaller Boxes, from £3.

IMPROVED REFLECTING GALVANOMETER,
for use with above, any resistance to 2000 ohms, £3.

Galvanometer Shunts, Galvanometer Lamps and Scales,
Keys, Single Coils, Batteries, &c.

Reliable Apparatus at low prices for teaching Mechanics, Hydrostatics, Heat, Optics, Magnetism and Electricity, as supplied to many of the leading Technical Institutes and Organised Science Schools.

Physical and Physiological List—Sixpence, Post free.

SECOND-HAND MICROSCOPES

By SWIFT, WATSON, CROUCH, BECK, ZEISS, LEITZ, &c.
Prices from £2 10s. to £45.

A Large Selection of Second-hand Powers and Fittings for all kinds of Microscopes.

Send for New List.

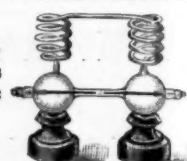
CLARKSON & CO., 28 Bartlett's Buildings, Holborn Circus, E.C.

GLASS BLOWING.

All kinds of Experimental Glass
Blowing carried out for Scientific
Men, Laboratories, &c.

INVENTORS' IDEAS WORKED OUT AS PER INSTRUCTIONS.

COSSOR,
67 Farringdon Road, E.C.



Hittorff's Tube showing the resistance of the dark space.

THE MOST NUTRITIOUS.

E P P S'S

GRATEFUL—COMFORTING.

C O C O A

BREAKFAST—SUPPER.

HARVEY & PEAK

HAVE FOR DISPOSAL

A VERY LARGE AND RARE PROJECTION POLARISCOPE.

Including Nicol Polariser of $3\frac{1}{2}$ inches aperture, Nicol Analyser of $3\frac{1}{4}$ inches aperture, many large Sections of Quartz, Quartz Devices, Crystals, Double Image Prisms, Selenites, &c., in Mahogany Cabinets.

56 CHARING CROSS ROAD, LONDON, W.C.

NUMBER TWELVE NOW READY.

THE SCHOOL WORLD.

A MONTHLY MAGAZINE OF EDUCATIONAL WORK AND PROGRESS.

Price SIXPENCE. Annual Subscription, including postage, 8s. net.

CONTENTS.

Some Dangers of Boarding-School Life. By Alfred Thompson.—**The Position and Teaching of German.** III.: Elementary Instruction. By E. L. Milner-Barry, M.A.—**The Salze Method of Teaching History.** (Illustrated.) By Ethel M. Reily.—**The Teaching of Analysis.** II. By E. W. Hurst, B.A.—**Drawing in Secondary Schools.** By A. W. Fenton Langman, A.R.C.A.—**The Present Position of Science in Secondary Education.**—**English History down to 1700.** 200 Noteworthy Topics arranged Alphabetically. By C. S. Fearnside, M.A.—**Notes for Lantern Lectures, The Starry Heavens.** By Professor R. A. Gregory, F.R.A.S.—**Boys' Interests.**—State Aid for Modern Language Teaching.—Elementary Education in 1898.—**Geography as a Means of Education.** By George G. Chisholm, M.A., B.Sc.—Some New Physical Apparatus. II. (Illustrated).—Current Geographical Topics. The Political Geography of South Africa. By Dr. A. J. Herbertson, F.R.G.S.—Items of Interest: General; Scotch; Irish; Welsh; Current History.—The School Pulpit: All are Teachers and all Learners for Good or Bad. By the Master of Wellington College.—A New Translation of Apian.—An Indispensable Handbook of Geography. (Illustrated.)

* Also Ready, Volume I., containing Nos. I.-XII., January to December 1899, Demy 4to, 480 pp. Index. Price 7s. 6d. net; Cloth Cases for binding Vol. I., 1s. net.

MACMILLAN AND CO., LIMITED, LONDON.

HOLLOWAY'S OINTMENT CURES

Gout, Rheumatism, Lumbago, Sciatica, Cuts, Bruises, Sprains, &c.

INVALUABLE FOR ALL SKIN DISEASES.

Holloway's Ointment and Pills may be obtained of all Medicine Vendors.

THE ENTOMOLOGISTS' MONTHLY MAGAZINE.

Price Sixpence, Monthly.

Edited by C. G. BARRETT, G. C. CHAMPION, F.Z.S., J. W. DOUGLAS, W. W. FOWLER, M.A., F.L.S., R. McLACHLAN, F.R.S., E. SAUNDERS, F.L.S., and

LORD WALSHINGHAM, M.A., LL.D., F.R.S.

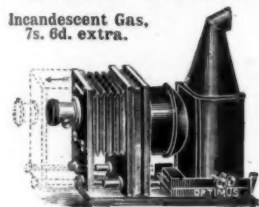
This Magazine, commenced in 1864, contains standard articles and notes on all subjects connected with Entomology, and especially on the Insects of the British Isles.

Subscription—Six Shillings per Annum, post free.

London: GURNEY & JACKSON (Mr. Van Voorst's Successors), 1 Paternoster Row.

"OPTIMUS" CANTILEVER PHOTOGRAPHIC ENLARGER.

Incandescent Gas, 7s. 6d. extra.



This already popular model is finished in a very superior and practical style. The lamp gives a brilliant and even light. The optical system is throughout the best. The Lens will be found to give a very flat field and good marginal definition.

* SUITED FOR POCKET CAMERA NEGATIVES.

Diam. of Condenser	... 4in.	5in.	6in.	8in.	10in.
Price, no Front Lens	... 62/-	70/-	80/-	110/-	200/-
Cover for Front Lens	... 27/-	37/-	37/-	63/-	63/-
Extra Covering Plates	... 3 1/2 x 3 1/2	4 1/2 x 3 1/2	6 1/2 x 4 1/2	8 1/2 x 5 1/2 in.	

Catalogue POST FREE.

"OPTIMUS" MAGIC LANTERNS FOR DRAWING ROOM AND LECTURE HALL.

Each Lantern is efficient for Exhibitions. The Lens gives crisp definition, being a superior Achromatic Photographic Combination, with Rack and Pinion, compound Condenser of 4in. diameter. Each has 3-wick Refulgent Lamp, and is Complete in box. (4-wick Lamp, 2s. extra.)



Mahogany outside Body, Panelled Door, Brass Stages, and 3-draw Sliding Tubes, so that lenses of long focus may be used when projecting upon a screen at a great distance, £5 5s.

Mahogany outside Body, lined with metal, making a thoroughly practical instrument, and really good value ... £2 12 0

Russian Iron Body, Brass Sliding Tubes (Educational)... 3 3 0

Do. do. (College) ... 2 8 0

PERKEN. SON & RAYMENT, 99 HATTON GARDEN, HOLBORN CIRCUS, E.C. LONDON.

BORD'S PIANOS

25 per cent. Discount for Cash, or 14/6 per month (second-hand, 10/6 per month) on the Three Years' System:—Lists free of

C. STILES & CO., 40 & 42 Southampton Row, London, W.C.

PIANOS EXCHANGED.

BECHSTEIN PIANOS

These magnificent Pianos for Hire on the Three Years' System at advantageous prices and terms. Lists and particulars free of

CHAS. STILES & CO., 40 & 42 Southampton Row, LONDON, W.C.

NOTICE.—Advertisements and business letters for NATURE should be addressed to the Publishers; Editorial communications to the Editor. The telegraphic address of NATURE is "PHUSIS," LONDON.

SUBSCRIPTIONS TO "NATURE."

	£	s.	d.
Yearly	1	8	0
Half-yearly	0	14	6
Quarterly	0	7	6
TO ALL PLACES ABROAD:—			
Yearly	1	10	6
Half-yearly	0	15	6
Quarterly	0	8	0

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
*Three Lines in Column	0	2	6
Per Line after	0	0	9
One Eighth Page, or Quarter Column	0	18	6
Quarter Page, or Half a Column	1	15	0
Half a Page, or a Column	3	5	0
Whole Page	6	6	0

* The first line being in heavy type is charged for as Two Lines.

Cheques and Money Orders payable to MACMILLAN & CO., Limited.

OFFICE: ST. MARTIN'S STREET, LONDON, W.C.



THE "HARRIS" MICROSCOPE.

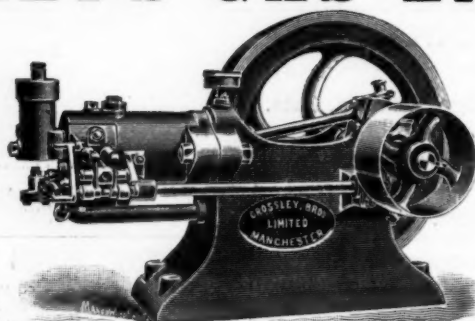
With Rackwork, £4 5 0
Without " £3 12 6

This is a first-class Microscope at a moderate price; it has fine adjustment of best design. Base is solid and rigid, and is designed for comfort in use. Complete with 2 Mirrors, Rotating Diaphragm, Eye-piece, 2 Achromatic Object Glasses, $\frac{1}{2}$ " giving 140 to 280 diameters and 1" giving 40 to 85 diameters. Draw Tube, Standard Screws.

The whole packed in Polished Mahogany Case.
If with $\frac{1}{2}$ " instead of 1", £3 17s. 6d.
Giving 170 to 340 diameters.

PHILIP HARRIS & CO., LTD., Chemical & Physical Apparatus Makers, BIRMINGHAM.
CROSSLEY'S GAS ENGINES.

RECENTLY
REMODELLED.



GREAT
REDUCTION
IN
GAS
CONSUMED.

CROSSLEY BROS., LTD., OPENSHAW, MANCHESTER.
WATSON'S NEW MICROSCOPES AND APPARATUS.



WATSON'S HOLOSCOPIC EYEPIECES, for use with either APOCHROMATIC or ACHROMATIC OBJECTIVES, an adjustment being provided to the special lenses employed, for altering the correction. There is no sacrifice of efficiency, the performance being equal to the most expensive Compensating or Huyghenian Oculars.

Magnifying Powers—

6 in. tube length, 5, 7, 10, and 14 diameters.
10 in. " 7, 10, 14, and 20 "

PRICE, in Student's Size and Pattern, either power, 17/6 each.

For Full Particulars see Supplemental List, Post Free.

WATSON'S PARACHROMATIC OIL IMMERSION CONDENSER.

Total aperture, 1.20; applanatic aperture exceeds 1.25. Undoubtedly the finest Condenser obtainable for high-power work. Optical part only ... £5 0 0
Completely mounted with Iris Diaphragm and Set of Stops ... £6 10 0

WATSON'S "SCHOOL" MICROSCOPE, New Model, complete with 1 in. Objective, in Case ... £3 3 0

WATSON'S "ROYAL" MICROSCOPE. A new model high-class instrument.

WATSON'S "FRAM" MICROSCOPE. A highest-class instrument at a very moderate cost.

BACTERIOLOGICAL APPARATUS. MICROTOMES. Apparatus for FIELD BOTANY and FIELD GEOLOGY. METAMORPHOSES and DISSECTED PREPARATIONS. BOTANICAL and PHYSIOLOGICAL MODELS.

For Particulars of all the above, see Watson's New Supplemental List to Catalogue No. 2, Post Free on application.

Watson's Catalogue (No. 3) is a Classified List representing a Stock of 40,000 first-class Micro-Slides, Post free on application.

W. WATSON & SONS (Established 1837), Opticians to H.M. Government.
313 HIGH HOLBORN, LONDON, W.C. New Branch Now Open: 16 FORREST ROAD, EDINBURGH. And at 78 Swanston Street, Melbourne, Australia. Awarded 39 Gold and other Medals at the principal International Exhibitions of the World.

THE NEW STIGMATIC LENS.

SERIES II. F/8.

BRITISH DESIGN AND WORKMANSHIP.

Is the best All-round Lens for either Professional or Amateur use.

Each lens will give perfect definition with full aperture to the extreme corners of the plate it is sold to cover; with smaller stops it will cover at least two sizes larger, giving perfect sharpness all over the plate, and thus becoming a wide-angle lens of the highest excellence. Either combination may be used separately, giving foci of about $1\frac{1}{2}$ and 2 times the length of that of the lens when used intact. The advantage of thus being able to choose the best point of view, irrespective of distance, will be at once apparent to the artistic worker.

EQUIVALENT TO FOUR LENSES AT THE PRICE OF ONE.

Eleven Sizes are now ready from $3\frac{1}{2}$ to 18 inches eq. focus.

CATALOGUE OF HIGH-CLASS CAMERAS AND LENSES, POST FREE.

J. H. DALLMEYER, Ltd., 25 NEWMAN STREET, OXFORD STREET, LONDON, W.

Printed by RICHARD CLAY AND SONS, LIMITED, at 7 & 8 BUCKINGHAM STREET, LONDON, W.1. In the City of London and LONDON by THE LONDON AND LONDON CO., LIMITED, at St. Martin's Street, LONDON, W.C., and THE MACMILLAN COMPANY, 66 FIFTH AVENUE, NEW YORK.—THURSDAY, NOV. 30, 1899.



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

NO. 1571, VOL. 61]

THURSDAY, DECEMBER 7, 1899.

[PRICE SIXPENCE.

Registered as a Newspaper at the General Post Office.]

[All Rights are Reserved.



NEWTON'S PATENT
Scientist's Biunial Lantern,
AS MADE FOR
Oxford and London University
Extension Lecturers, &c.

Highest quality only, £14 14s.
New Catalogue of Optical Lanterns,
Projection Apparatus, and Scientific
and other Slides, Four Stamps.

NEWTON & CO.,
Opticians to the Queen and
the Government,
3 FLEET STREET, LONDON.

LYELL'S STUDENTS' ELEMENTS OF GEOLOGY.

A NEW EDITION, THOROUGHLY REVISED AND
IN GREAT PART REWRITTEN BY

Professor J. W. JUDD, C.B., F.R.S.,
Of the Royal School of Mines.

With upwards of 600 Illustrations.
Crown 8vo. 9s.

"It was a happy thought to entrust the preparation of so important a manual to one of the most intimate, and certainly not the least eminent, of the surviving friends of Sir Chas. Lyell. . . . It is hardly too much to say that Lyell's 'Principles of Geology' is not unworthy to stand side by side with Darwin's 'Origin of Species' as an epoch-making book in modern science"—*Standard*.

JOHN MURRAY, ALBEMARLE STREET, W.

CHESHIRE'S AND CROVA'S DISCS.

FOR ILLUSTRATING STATIONARY AND
PROGRESSIVE SOUND WAVES.

We are now making accurate Cardboard Models
of the above, for individual Student's use.

Price of the Set, consisting of two 10-inch Discs and Slit,
with full instructions, 1s.

JOHN J. GRIFFIN & SONS, L^d
20-26 SARDINIA STREET, LONDON, W.C.

CHRISTMAS PRESENTS. NEGRETTE & ZAMBRA'S



IMPROVED
SELF-RECORDING RAIN-
GAUGES, BAROMETERS &
THERMOMETERS.

Giving continuous Records
on Charts which only require
changing weekly.

Invaluable to Invalids and
others unable to take daily
readings.

"Special" Illustrated Price List of Instruments, suitable for
Presents, free by Post to all parts of the World.

NEGRETTE & ZAMBRA,
38 HOLBORN VIADUCT, E.C.
BRANCHES: 45 CORNHILL, and 122 REGENT STREET.

THE DAVY-FARADAY RESEARCH LABORATORY

OF THE ROYAL INSTITUTION.

DIRECTORS:

The Right Hon. LORD RAYLEIGH, M.A., D.C.L.,

LL.D., F.R.S.

Professor DEWAR, M.A., LL.D., F.R.S.

SUPERINTENDENT OF THE LABORATORY:

Dr. ALEXANDER SCOTT, M.A., D.Sc., F.R.S.

This Laboratory was founded by Dr. Ludwig Mond, F.R.S., as a Memorial of Davy and Faraday, for the purpose of promoting, by original research, the development and extension of Chemical and Physical Science.

The Laboratory is open free of charge to Workers of either sex, and any nationality, prosecuting individual investigations; and the extensive collection of Physico-Chemical Apparatus presented by the Founder is available for their use, together with such materials, chemicals, electricity, &c., as the Directors may authorise.

Assistants and a trained mechanic are attached to the Laboratory to aid Workers in the prosecution of their researches.

All persons desiring to be admitted as Workers must send evidence of scientific training, qualification, and previous experience in original research, along with a statement of the nature of the investigation they propose to undertake.

Michaelmas Term.—Monday, October 2, to Saturday, December 16.

Least Term.—Monday, January 8, to Saturday, April 7.

Easter Term.—Monday, April 30, to Saturday, July 28.

Forms of Application can be had from the ASSISTANT SECRETARY, Royal Institution, Albemarle Street, W.

BACTERIOLOGY.

BACTERIOLOGICAL DEPARTMENT, KING'S COLLEGE, LONDON.

Director: PROF. CROOKSHANK.

The Laboratories are open daily for Instruction and Research from 10 a.m. to 5 p.m. For Syllabus of Classes apply THE SECRETARY.

For Information and Advice as to the Course of Instruction to be selected, application must be made in writing to PROF. CROOKSHANK, or an interview may be obtained by appointment.

SPECIAL CLASSES IN JANUARY.

Two complete Courses of Practical Instruction for Medical Practitioners, Veterinary Surgeons, Analysts, &c., will commence on January 8th.

Demonstrations to the Morning Class (Dr. NEWMAN, D.P.H.) will be given at 11 a.m., and to the Afternoon Class (Dr. NASH, D.P.H.) will be given at 2 p.m.; three days' work, with practical work daily in the Laboratory for THIRTY DAYS.

A Class for Candidates for the D.P.H. (Bacteriology) will commence on January 8th at 10 a.m., and a Time Table arranged to suit the convenience of the Class.

A Class in Clinical Bacteriology, consisting of Demonstrations with practical work, will commence on Wednesday, January 10th (at 3.30), and be held on successive Wednesdays for six weeks.

THE LONDON SCHOOL OF TROPICAL MEDICINE

(UNDER THE AUSPICES OF HER MAJESTY'S GOVERNMENT),
CONNAUGHT ROAD, ALBERT DOCK, E.

IN CONNECTION WITH THE HOSPITALS OF THE SEAMEN'S
HOSPITAL SOCIETY.

The next SESSION commences on MONDAY, JANUARY 15, 1900.

A Travelling Scholarship of £300 will be offered to Students of the School.

The Laboratories, Museum, Library, &c., are open daily. Lectures on Tropical Medicine, Tropical Hygiene and Surgery in the Tropics, are delivered during the Session.

Clinical Instruction is given daily in the wards of the Hospitals.

Special arrangements for Board will be made for those who may desire to reside on the premises.

For Prospectus, Syllabus, and other particulars, apply to the Secretary, P. MICHELLI, Esq., Seamen's Hospital, Greenwich, S.E.

HEATHCOTE SCIENCE LABORATORIES.

These Laboratories are open for RESEARCH work, at any hours or times most convenient for worker, in CHEMISTRY, PHYSICS and BACTERIOLOGY. Facilities for Commercial investigations are supplied. Furnaces and powerful Electrical Currents can be used.

The Fees are at rate of £3 3s. for one month (five days a week, six hours a day). Apparatus supplied free.

Private Laboratory, £4 14s. 6d. a month, or by arrangement.

The above Fees include use of all ordinary Glass and other Apparatus, and use of Accurate Balances and Standard General Instruments, also Furnaces, &c.

9 Heathcote Street, Mecklenburgh Square, | R. C. T. EVANS,
Gray's Inn Road, W.C. | Director.

SCIENCE EXAMINATIONS.

For LONDON and other UNIVERSITIES, the
CONJOINT BOARD, &c.

Well-equipped LABORATORIES, DAY AND EVENING. Personal
or Class Tuition.

"R.," 9 Heathcote Street, Gray's Inn Road, W.C.

INSTRUCTION IN PURE CULTIVATION OF YEAST,

According to HANSEN'S Methods.

Courses for Beginners, as well as for Advanced Students, in Physiology and Technology of Fermentations—Biological Analysis of Yeast.

Manuals:—E. Chr. Hansen: "Practical Studies in Fermentation." London (Spon), 1896. Alfred Jørgensen: "Micro-organisms and Fermentation." London (F. W. Lyon), 1893.

Further Particulars on Application to the Director, ALFRED JØRGENSEN, The Laboratory, Copenhagen, V.

LONDON MATRICULATION AND HOSPITAL SCHOLARSHIPS.

QUERNMORE.

Special Preparation for the above, Privately, in Class, or by Correspondence, by Messrs. JOHN GIBSON (First Class, Cambridge) and G. L. L. (First Class, London), with large Staff of Specialist Tutors. Resident Pupils received at Upper Norwood. Long list of successes on application.

N.B.—The London Matriculation Guide, with Examination Papers and Solutions (price 1s.), is issued each January and June.

Address: Messrs. GIBSON & L. L., 24 Chancery Lane, W.C.

B.A. AND B.Sc.

MATRICULATION, INTERMEDIATE, FINAL.

PREPARATION BY CORRESPONDENCE AND ORAL TUITION on a THOROUGHLY INDIVIDUAL SYSTEM. Fees based on success.

The STAFF includes Graduates of Oxford, Cambridge, London, and Royal Universities, Science Medallists, Prizemen, Scholars, &c.

SINGLE SUBJECTS TAKEN: Latin, Greek, French, German, Mathematics, Science, Logic, Psychology, Political Economy, &c.

For Terms, &c., address Mr. J. CHARLESTON B.A. (London and Oxon.), The Burlington Classes, 27 Chancery Lane, London, W.C.

Telegrams—"Tunzelmann, London."

THE ELECTRICAL

AND

GENERAL ENGINEERING COLLEGE.

PRESIDENT—G. W. DE TUNZELMANN, B.Sc. Lond., M.I.E.E.

PRINCIPAL—J. H. REEVES, M.A. Cantab.

Next SESSION begins WEDNESDAY, SEPTEMBER 27.

Particulars on application to the SECRETARY, 2 and 4 Penywern Road, Earl's Court, S.W.

GOVERNMENT GRANT OF £4000 TO

DEFRAY THE EXPENSES OF SCIENTIFIC INVESTIGATIONS. Applications for the year 1900 to be considered at the Annual Meeting of the Government Grant Committee, must be forwarded to the CLERK to the Government Grant Committee, Royal Society, Burlington House, London, W., by January 31, and must be written upon Printed Forms, which can be obtained from the CLERK.

EAST LONDON TECHNICAL COLLEGE.

ASSISTANT DEMONSTRATOR is Required in the Day School, Physics Laboratory. Commencing Salary, £60.

Applications should be addressed to the TREASURER.

Required shortly in a Scientific Department

in the Colonies, a capable TECHNICAL ASSISTANT. Age 25 to 35. Qualifications:—Preferably a Graduate in Natural Science Honours; well informed in current Scientific work, chiefly Biological; proficient in French and German; and with good experience in correcting and editing papers for the press—latter essential. Salary, £300 to £400, according to experience, with a First Class Passage.—Address, stating full particulars, to Mr. HARRIES, 63 Victoria Street, S.W.

WANTED.—By a leading London Firm of

Scientific Instrument Manufacturers, an ASSISTANT to PHYSICS MANAGER. Good grounding in Experimental Physics essential. One with Commercial Experience preferred.—State full particulars, also Wages required, to "EXPANSION," NATURE Office.

EXPERIMENTAL WORKS, BATH.—

Facilities for conducting Scientific and Mechanical Investigations. Pupil taken. Seventy acres of ground.—Apply to MANAGER.

MOA SKELETONS.

Very fine, well-mounted, Specimen of *Eurapteryx crassa* and *Meiornis casuarinus*, suitable for Public or Private Museum; also legs and feet of *Dinornis robustus*.—O. E. JANSON & SON, Natural History Agents, 41 Great Russell Street, London, W.C.

Sale by Auction.

MONDAY, DECEMBER 11.

A SPECIAL SALE OF LANTERNS, SLIDES, AND APPARATUS.

MR. J. C. STEVENS will Sell by Auction,

at his Great Rooms, 38 King Street, Covent Garden, as above, at half-past 12 o'clock precisely, by order of the Executors of a Gentleman deceased, several valuable Lanterns by leading Makers, and a large quantity of Lantern Accessories; also fine Collection of Hand-painted and other Slides, &c.

On View the Saturday prior, 10 till 4, and morning of Sale, and Catalogues had.

H. J. GLAISHER'S NEW BOOKS.

Nearly Ready, Demy 8vo, Price 7s. 6d. net; by Post 7s. 10d.

THE LETTSMAN LECTURES ON GRANULAR KIDNEY. By SAMUEL WEST, M.D., F.R.C.P., Senior Physician, Royal Free Hospital; Asst. Physician, St. Bartholomew's Hospital.

Demy 8vo, Cloth, Price 5s. net; by Post 5s. 4d.

CLINICAL LECTURES ON NEURASTHENIA. Comprising a complete Account of its Symptoms, Pathology and Treatment. By THOMAS D. SAVILL, M.D.

Now Ready, Crown 8vo, Cloth, Price 2s. net; by Post 2s. 3d.

CANCER, Illustrated by 1000 Cases from the Registers of the Middlesex Hospital and by 50 Selected Cases of Cancer of the Breast, &c., &c. By T. W. NUNN, F.R.C.S. With Plates of Microscopical Sections.

Ready Shortly.

STUDIES IN HUMAN AND COMPARATIVE PATHOLOGY. By WOODS HUTCHINSON, A.M., M.D., Professor of Comparative Pathology, University of Buffalo, Medical Department.

Nearly Ready, Sewed, Crown 8vo, Price 1s. 6d. net; by Post 1s. 8d.

CONSUMPTION: ITS NATURE AND TREATMENT. By WILLIAM H. SPENCER, M.A., M.D., Cantab., M.R.C.P. Lond., Consulting Physician to the Bristol Royal Infirmary; formerly Lecturer on the Principles and Practice of Medicine, and on Pathology, at University College, Bristol, Medical School.

Second Edition, Royal 8vo, Cloth, Price 3s. 6d. net; by Post 3s. 10d.

ON THE STUDY OF THE HAND FOR INDICATIONS OF LOCAL AND GENERAL DISEASE. By EDWARD BLAKE, M.D., M.R.C.S. Rewritten and much Enlarged, including a New Section on the Pulse—Chloroform Syncope, a New Treatment on purely scientific lines—the immediate cure of Engorged Liver. 36 Illustrations.

H. J. GLAISHER,

57 WIGMORE STREET, LONDON, W.

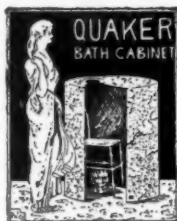
THE
QUAKER BATH CABINET

Should be in Every Home for HOT-AIR, VAPOUR, or MEDICATED BATHING PURPOSES.

Makes Clean, Healthy, Strong and Vigorous Men and Women.

NATURE'S COMPLEXION BEAUTIFIER.

Cures a Bad Cold with One Bath, Averts Fevers, La Grippe, &c.



Cures the most obstinate cases of Rheumatism, Obesity, Neuralgia, La Grippe, Malaria, Catarrh, Piles, Dropsy, all Blood, Skin, Kidney, and Nervous Troubles.

25s. each, post free,

Sent ready for immediate use.

RECOMMENDED BY THE
BEST PHYSICIANS.

Folds into 3 in. by 28 in. space; weighs 7 lbs.

These Health Baths should be taken by all persons, whether healthy or unhealthy, at least once or twice a week. They open the 5,000,000 sweat pores of the skin, and force out by Nature's method all the impure, poisonous matter which causes disease.

Soap and water simply cleanse the surface or outside of the body, while these Thermal Baths cleanse inwardly and outwardly, making the blood pure, sleep sound, skin soft, white and beautiful. They prevent disease.

Descriptive (Z) Pamphlet Post Free.

THE GEM SUPPLIES CO.,
6 BISHOP'S COURT, CHANCERY LANE, LONDON, W.C.

WEBSTER'S INTERNATIONAL DICTIONARY
OF THE ENGLISH LANGUAGE.

One Volume, Cloth, £1 11s. 6d.

A PRACTICAL, HANDSOME AND CHEAP XMAS PRESENT
FOR THE MAN OF SCIENCE AND THE MAN OF AFFAIRS.

It excels in the ease with which the eye finds the word sought; in accuracy of definition; in effective methods of indicating pronunciation; and in terse and comprehensive statements of fact.

WEBSTER'S DICTIONARY has been so long and so well known that it seems superfluous to say much as to its great merits and **practical usefulness.** In order that the book may continue to deserve its success every pains have been taken to keep it thoroughly abreast with **modern scholarship.**

In the year 1891 was issued the Third Edition, which can fairly claim to be practically a new book. This edition was reprinted with corrections in 1892 and 1894, and **was revised in 1897.** Its vast superiority over former editions is attested by the following facts:—

The whole work has been reset in new type from beginning to end. The preceding edition, with all its supplementary matter, has been re-studied **line by line.**

A close comparison has been made with a whole library of the most recent works on **philology** and all branches of knowledge that include new usages of speech.

Upon **technical** subjects specialists have been employed, and their contributions have been carefully harmonised in form with the general principles of the revision.

Great care has been devoted to the **illustrations;** the number has been increased from **3000** to nearly **4000,** and about two-thirds of them are entirely new.

THE ATHENÆUM.—" . . . The publication of this volume of 2118 pages ought to be regarded with gratitude as a remarkable and beneficent achievement."

This Dictionary is issued in one or two volumes, bound in various styles, at prices ranging from **£1 11s. 6d.** to **£3 15s.** The Half-Calf Binding, price **£2 2s.,** is strongly recommended.

On receipt of a Postcard mentioning **NATURE,** a detailed Prospectus will be sent Post free.

LONDON: GEORGE BELL & SONS, YORK STREET, COVENT GARDEN.

THE SCIENTIFIC ROLL AND MAGAZINE OF SYSTEMATIZED NOTES.

THIS WORK IS A VALUABLE
GUIDE, BIBLIOGRAPHY, AND INDEX TO SCIENCE.

This work, now in course of publication, embraces:

1. A *Bibliography* classified according to subjects arranged (1) according to the year of publication, and (2) alphabetically under each year according to the name of the author; each item has its distinctive number for reference purposes.

2. An *Index*, which, although arranged alphabetically, is classified in groups more than is usual in an index, the object being to render it possible, at some future time, to amalgamate the various subject indexes into one general classified index.

3. A *Systematized Collocation of Facts* grouped according to their relationship to each other. The aim of the whole is to enable any person engaged in scientific research to find the information he seeks with a minimum expenditure of trouble, time and cash.

As the work is the result of forty years' labour, its main features cannot be fully described in a short advertisement. All persons interested in the classification of scientific data, especially those commencing a research, are invited to send for a prospectus and fuller particulars to

A. RAMSAY,
4 Cowper Road, Acton, London, W.

THE GEOGRAPHICAL JOURNAL.

Price 2s. CONTENTS—DECEMBER.

Opening Address, Session 1899-1900. By the President.—Travels in Bokhara. By Willy Rickmer Rickmers.—New Light on some Mediaeval Maps. By C. Raymond Beazley, M.A.—Regions of the Benue. By Lieut. H. Moseley.—Mr. Jenner's Expedition from Kismayu to Logh, on the Juba.—Recent Journey from Shanghai to Bhamo through Hunan. By Captain A. M. S. Wingate.—International Oceanographical Research.—Bartholomew's Physical Atlas: A Review. By Hugh Robert Mill, D.Sc., F.R. Met. Soc.—Three Recent Books on China: Review. By Geo. G. Chisholm, M.A., B.Sc.—The International Geography: Review. By Major L. Darwin.—The Monthly Record.—Correspondence: On the Advance and Retreat of Sea-ending Glaciers. By Sir Martin Conway.—Patagonia. By A. M. Robinson.—Meetings of the Royal Geographical Society, Session 1899-1900.—Geographical Literature of the Month.—Numerous Maps and Illustrations.

London: EDWARD STANFORD, 26-27 Cockspur Street, Charing Cross.

LAMLEY & CO.

JUST PUBLISHED.

PRIMEVAL SCENES.

Being some Comic Aspects of Life in Prehistoric Times.

By the Rev. H. N. HUTCHINSON,
Author of "Extinct Monsters." Imp. 4to, 6s.

Twenty-five full-page Drawings and an original Cover Design by J. HASSALL and F. V. BURRIDGE, illustrating some comic aspects of life in prehistoric times, with a few lines of explanatory text to each picture.

The Author has taken great pains to show the public that "Prehistoric Peeps" may be amusing, and at the same time drawn strictly in accordance with scientific discovery.

{LAMLEY & CO, 1 and 3 EXHIBITION ROAD, S.W.

Just Published. With 564 Illustrations. Large Crown 8vo.
10s. 6d.

A TEXT-BOOK OF PHYSICS.

By W. WATSON, B.Sc.,
Assistant Professor in Physics in the Royal College of Science, London;
Assistant Examiner in Physics, Science and Art Department.

For use in Technical Schools, Advanced Science and Art
Classes, Engineering Schools, Universities, &c.

London: LONGMANS, GREEN, & CO.

C. E. MÜLLER & CO., SCIENTIFIC GLASS BLOWERS

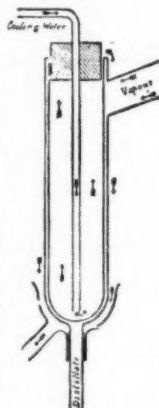
AND

Manufacturers of Chemical
and Physical Apparatus.

PATENT DOUBLE
SURFACE CONDENSER

Extremely Small and Light,
Great Efficiency.

PARTICULARS OF ABOVE AND PRICE
LISTS OF APPARATUS ON
APPLICATION TO



148 HIGH HOLBORN,
LONDON, W.C.

IMPROVED D'ARSONVAL GALVANOMETERS.

PRICES

£10-0-0

AND

£4-10-0

LIBERAL DISCOUNTS.

Most
SENSITIVE
for
DEFLECTIVE,
ZERO,
or
BALLISTIC
WORK.



Write for Price List and Particulars of Potentiometers,
Galvanometers, Electrical Thermometers, Experi-
mental Direct and Alternating Current Sets, &c., to

CROMPTON & CO., LD.,

Laboratory { "THRIPLANDS," } LONDON, W.
KENSINGTON COURT,

QUARTZ FIBRES.

We are now making **QUARTZ FIBRES** about 40 cm. long, capable of supporting a weight of 50 grammes. These are especially suitable for suspending heavy magnets.

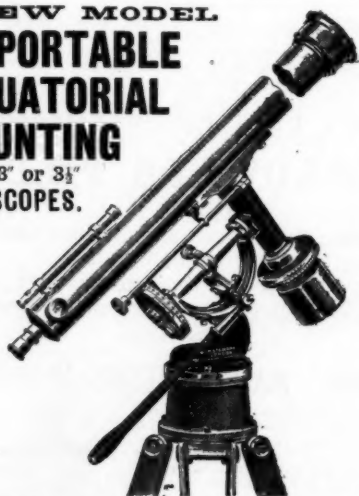
Price of Box containing 6 of these Fibres,
£1 0 0

FIBRES SUITABLE FOR GALVANOMETER SUSPENSIONS.

In Box containing 6 Fibres 16 cm. long	-	5	0
" " " 30 "	-	7	6
" " " 40 "	-	10	0

SCIENTIFIC INSTRUMENT CO.
LIMITED,
CAMBRIDGE.

NEW MODEL PORTABLE EQUATORIAL MOUNTING For 3" or 3½" TELESCOPES.



Latitude Adjustment, Clamp for Declination Axis, Quick and Slow Motion, in Right Ascension.

EQUATORIAL MOUNTING with Divided Circles and Stand fitted with short Iron Column, Levelling Screws, and Metal Stretcher; £15 15s.; or, complete with 3" Telescope, £25.

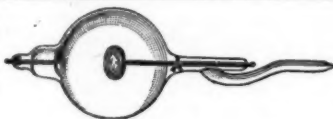
ILLUSTRATED CATALOGUE GRATIS.

J. H. STEWARD,
OPTICIAN,
406 STRAND, 457 WEST STRAND,
7 GRACECHURCH STREET, LONDON.

LATEST PUBLICATIONS OF THE ZOOLOGICAL SOCIETY OF LONDON.

THE ZOOLOGICAL RECORD, Vol. 35.

Being Records of Zoological Literature relating chiefly to the Year 1898. Edited (for the Zoological Society of London) by D. SHARP, M.A., F.R.S., F.Z.S., &c. London, 1899. 8vo. Price 30s. To be obtained at the Society's Office (3 Hanover Square, W.), or through any Bookseller.



COSSOR,
67
FARRINGTON RD.,
E.C.

Original Maker of "X" RAY TUBES in England.

FOCUS TUBES giving finest possible definition. **IMPROVED TUBE HOLDERS**, with arrangement for securing wires to avoid perforation of tube. All kinds of "X" Ray Apparatus, Mercury Pumps, Screens, Spark Gaps, &c. Applications for Price Lists invited.

For Photography, Unsurpassed for fine definition.

COOKE LENSES

TAYLOR, TAYLOR, & HOBSON,
Stoughton Street Works, Leicester;
and 18 Berners Street, London, W.

PHŒNIX FIRE OFFICE,
19 LOMBARD ST., E.C., and 57 CHARING CROSS, S.W.
ESTABLISHED 1782.

MODERATE RATES. ABSOLUTE SECURITY.
ELECTRIC LIGHTING RULES SUPPLIED.
LIBERAL LOSS SETTLEMENTS.
PROMPT PAYMENT OF CLAIMS.
FRANCIS B. MACDONALD, SECRETARY.
LOSSES PAID OVER £22,000,000.



**WHEN
BUYING
YOU
WANT
THE
BEST.**

**IF YOU BUY A SMITH PREMIER
TYPEWRITER . . .**

**YOU WILL HAVE
THE VERY BEST.**

One that will do the work, do it well, keep on doing it well, even if it is used all the time, and hard at that.

**CHEAP TYPEWRITERS SOON
SHOW SIGNS OF WEAR & TEAR.**

The SMITH PREMIER is built for work, and will outlast any other typewriter. . . .

**The Smith Premier
Typewriter Co.,**

14, Gracechurch Street,
London, E.C.

CO-OPERATIVE WORLD TRAVEL

Organised by HENRY S. LUNN, M.D., F.R.G.S.,
W. HOLDSWORTH LUNN, & CONNOP F. S. PEROWNE.

A Cruise to the WESTERN MEDITERRANEAN.

TILBURY, GIBRALTAR, TANGIER, ALGIERS, PALMA, VILLE-
FRANCHE (for NICE, CANNES, MONTE-CARLO), MARSEILLES.

A FIFTEEN DAYS' CRUISE FOR £9 9s. AND UPWARDS.

A Cruise to the EASTERN MEDITERRANEAN.

(Return ticket to MARSEILLES included.)

MARSEILLES, SYRACUSE, PIRÆUS (for Athens),
CONSTANTINOPLE, JAFFA (for Jerusalem), ALEXANDRIA,
MALTA, NAPLES, MARSEILLES.

A THIRTY-FIVE DAYS' CRUISE FOR £36 15s. AND UPWARDS
s.v. ARGONAUT. Tonnage, 3254; h.-p., 4000.

Full particulars from the Secretary, 5 Endsleigh Gardens,
Euston, London, N.W.

ESTABLISHED 1851.

BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

INVESTED FUNDS

£10,000,000.

The BIRKBECK ALMANACK, with full particulars, post free.
FRANCIS RAVENSCROFT, Manager.

THE MOST NUTRITIOUS.

E P P S'S

GRATEFUL—COMFORTING.

C O C O A

BREAKFAST—SUPPER.

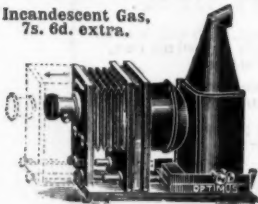
TO SCIENCE LECTURERS.
HUGHES' MOTO-PHOTOSCOPE FOR LIVING PICTURES.
THE MOST PERFECT.

No SHUTTER, therefore no Flickering. Superb Mechanism.

The Moto-Photo Camera for taking the Pictures. Illustrated Lists, &c. See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN, &c. Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great success. New Oxhydrogen Microscope. Science Lanterns for Class Demonstration. Magnificent Results. Docwra Triple, Prize Medal, Highest Award. Supplied to the Royal Polytechnic Institution, Dr. H. GRATTAN GUINNESS, Madame ADELINA PATTI, &c. Patent Pamphengos Science Lanterns. The Universal Lantern 4-inch Condensers, 4-wick Lamp, Portrait Combination front Lenses, 18s. 6d., Marvellous value. Science Lecture Sets. Novelties. The Lantern Kaleidoscope. Cheapest Lantern Outfits in the World. Grandly Illustrated Catalogue, over 180 choice Engravings, 6d.; Postage, 3d. List of 300 Lecture Sets, Science Subjects, Views, &c., 6d.; Postage 3d. Pamphlets Free. W. C. HUGHES, SPECIALIST, Brawster House, 82 Mortimer Road, Kingsland, N.

"OPTIMUS" CANTILEVER PHOTOGRAPHIC ENLARGER.

Incandescent Gas,
7s. 6d. extra.



This already popular model is finished in a very superior and practical style. The lamp gives a brilliant and even light. The optical system is throughout the best. The Lens will be found to give a very flat field and good marginal definition.

* SUITED FOR POCKET
CAMERA NEGATIVES.

Diam. of Condenser	5in.	6in.	8in.	10in.
Price, no Front Lens	62/-	70/-	80/-	110/-
Extra for Front Lens	27/-	27/-	37/-	63/-
Covering Plates	3 1/2 x 3 1/2	4 1/2 x 3 1/2	6 1/2 x 4 1/2	8 1/2 x 5 1/2 in.

Catalogue POST FREE.

PERKEN, SON & RAYMENT,

WATKINS & DONCASTER,

NATURALISTS,

AND MANUFACTURERS OF

CABINETS AND APPARATUS

FOR ENTOMOLOGY, BIRDS' EGGS, AND ALL BRANCHES OF
NATURAL HISTORY.

SPECIAL SHOW-ROOM FOR CABINETS.

Call or send for detailed Catalogue (86 pp.), Post free on application.

N.B.—For Excellence and Superiority of Cabinets and Apparatus, references are permitted to distinguished patrons, Museums, Colleges, &c.

A LARGE STOCK OF INSECTS AND BIRDS' EGGS.

Birds, Mammals, &c., Preserved and Mounted by First-class Workmen with true natural surroundings. All Books and Publications on Natural History supplied.

36 STRAND, LONDON. W.C.

(Five Doors from Charing Cross.)

MINERALS, ROCKS & FOSSILS.

COLLECTIONS FOR STUDENTS.

Carefully labelled and arranged in Boxes with Card Trays.

50 Minerals, 12/6; 100 do., 21/-; 200 do., 42/-.

Rocks and Fossils at similar prices.

300 Minerals in Cabinet, £4 4s.; 400 do., £5 12s. 6d.

Catalogues Post Free.

THOMAS D. RUSSELL,

78 NEWGATE STREET, LONDON, E.C.

PHYSIOGRAPHY and GEOLOGY.

COLLECTIONS & MICROSCOPIC SLIDES,

As advised by Science and Art Directory, arranged by

JAMES R. GREGORY & CO.,

Mineralogists, &c.

To Science and Art Department, British, Indian and Colonial
Museums, &c.

NOVELTIES and RARE GEMS and PRECIOUS
STONES.

Mineral Specimens for Museums, and Collectors, and all purposes.
Rock Specimens and Microscopic Sections of Rocks and Minerals
cut to order.

NEW AND VALUABLE MINERAL SPECIMENS CONSTANTLY
ARRIVING.

Stores & Offices: 1 Kelso Place, KENSINGTON, W.
NEW CATALOGUES AND LISTS FREE.

HOLLOWAY'S PILLS

CURE

Biliousness, Sick Headache, Indigestion, and
all Internal Complaints.

CAN BE TAKEN BY THE MOST DELICATE.

Holloway's Pills and Ointment may be obtained of
all Medicine Vendors.

"OPTIMUS" MAGIC LANTERNS

FOR DRAWING ROOM
AND LECTURE HALL.

Each Lantern is efficient for Exhibitions. The Lens gives crisp definition, being a superior Achromatic Photographic Combination, with Rack and Pinion, compound Condenser of 4in. diameter. Each has 3-wick Refulgent Lamp, and is Complete in box. (4-wick Lamp, 2s. extra.)



Mahogany outside Body, Panelled Door, Brass Stages, and 3-draw Sliding Tubes, so that lenses of long focus may be used when projecting upon a screen at a great distance, £5 5s.

Mahogany outside Body, lined with metal, making a thoroughly practical instrument, and really good value ... £2 12 0

Russian Iron Body, Brass Sliding Tubes (Educational)... 3 3 0

Do. do. (College) ... 2 8 0

99 HATTON GARDEN,
HOLBORN CIRCUS, E.C. LONDON.

W. G. PYE & CO.

30 ST. ANDREW'S STREET, CAMBRIDGE.



PRICE £23 15 0.

CAMBRIDGE
ROCKING
MICROTOME.WITH
ORIENTATING
OBJECT-
HOLDER and
PATENT
CLUTCH, which

affords easy

Adjustment in all directions without the aid of Thumb-Screws.
EMBEDDING BATH for Mounting Specimens with Pans,
Vials, Gas Burner Regulator, Stand, and Paraffin com-
plete, ready for use £2 2 0Or **MICROTOME and BATH** together £5 13 6For **FLAT CUTTING** and other **MICROTOMES**, see List.PRICE LIST of Physical and Physiological Apparatus Now Ready
Price Sixpence, Post free.**JAS. SWIFT & SON,**
MANUFACTURING OPTICIANS.SOLELY APPOINTED TO THE A.M. DEPT.
WAR OFFICE, FOR THE SUPPLY
OF MICROSCOPES.Patent form of Student's Microscope,
fitted with $2\frac{1}{3}$ " and $1\frac{1}{6}$ " Pan-Aplanatic
Objectives, Iris Diaphragm and Oculars,
in Case, from

£5 5s.

These Instruments we have supplied in
numbers to the following Medical Schools,
viz. St. Mary's, St. Bartholomew's, Guy's,
Middlesex, London, and St. Thomas's.Seven Gold Medals awarded for excel-
lence of manufacture.

Catalogue on Application.

81 TOTTENHAM COURT ROAD, W.

PATENTS.**JAMES G. LORRAIN, M.I.E.E., M.I.MECH.E., &c.,**
CHARTERED PATENT AGENT,

Norfolk House, Norfolk Street, LONDON, W.C.

Speciality—**PHYSICAL PATENTS,****OPPOSITIONS, AND AMENDMENTS.**

Charges on Application.

Telephone No. 2511 GERRARD.

Telegrams: "LORRAIN, LONDON."

"Patentees' Handbook" Post free on application.

C. BAKER'S
MICRO-SLIDE LENDING DEPT.

SUBSCRIPTION: £1 1 0

For 12 Deliveries of 20 Slides each, Post free both ways
CATALOGUES,**MICROSCOPES,**
TELESCOPES, &c.

Post free on application.

244 HIGH HOLBORN, LONDON.

THE
AERIAL
GRAPHOSCOPE
(BRUCE'S PATENT).Showing Lantern Pictures in Space and Relief without a
Screen, Weird Ghost Effects and Visions, and a variety of
Entirely Original Experiments on Persistence of Vision.Exhibited at the Soirées of the Royal Society, Royal Insti-
tution, Society of Arts, London Institution, &c., &c.The Inventor, **Mr. ERIC STUART BRUCE, M.A.**
Oxon., F.R. Met. Society, can accept Engagements for his
Elaborately Illustrated Lecture on this complete Novelty, also
for shorter Demonstrations at Soirées, Photographic Exhi-
bitions, and other Entertainments.

APPLY TO

E. S. BRUCE, Esq.,19 CAMPDEN HOUSE ROAD, KENSINGTON,
LONDON, W.**FOR XMAS PRESENTS.****A NEW STEREOSCOPIC BINOCULAR**
FIELD GLASS

Of NEW FORM and CONSTRUCTION.

(English Patents, Nos. 5639 and
7942, 1894.)Of handy size, with large
field, brilliant definition, perfect
achromatism, and very decided
STEREOSCOPIC effect, and
which, when once adjusted, are
always ready for use.

Prices: £6 to £8.

For **NAVAL MEN** and **DEERSTALKERS**, &c. (we have made
larger sizes for **NIGHT** and **DAY USE**, admitting more light, but
of somewhat greater weight). Prices: Night, £10; Day, £11.

Illustrated Price List free.

CARL ZEISS (of JENA),

29 MARGARET STREET, REGENT STREET, LONDON, W.

PHYSICAL AND MECHANICAL
APPARATUS.**EVERETT & CO.,**

Engineers and Electricians,

22 CHARTERHOUSE SQUARE, LONDON, E.C.

Scientific and Electrical Instrument Makers.

Apparatus for Laboratories, &c., designed and made to meet any
requirements.

MACHINES FOR ANY SPECIAL PURPOSE BUILT TO ORDER.

MODELS DESIGNED AND MADE FOR INVENTORS.

Accuracy combined with Highest Skill at Reasonable Charges.

REPAIRS OF EVERY DESCRIPTION.

BORD'S PIANOS
BECHSTEIN PIANOS25 per cent. Discount for Cash, or 14/6 per month (second-hand, 10/6 per
month) on the Three Years' System. Lists free of
C. STILES & CO., 40 & 42 Southampton Row, London, W.C.
PIANOS EXCHANGED.These magnificent Pianos for Hire on the Three Years' System at
advantageous prices and terms. Lists and particulars free of
CHAS. STILES & CO., 40 & 42 Southampton Row,
LONDON, W.C.

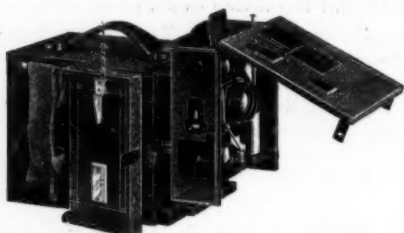
THE "N. & G." CAMERAS FOR HAND AND TRIPOD.

In all sizes up to 7 x 5 in. For Plates, Cut Films or Film in Spools.

A Series of High-Class Instruments for SERIOUS WORK, embodying every New Advance in Photography.

Prices from £13 to £50.

Have been in Constant Use FOR EIGHT YEARS in all Parts of the World.



"N. & G." Camera, open, to show Fittings and Movements.

**TRIPOD CAMERAS,
SURVEYING CAMERAS,
and very Small and Light
POCKET CAMERAS**
for Travellers and Field Naturalists.

SPECIALITY: COMPLETE OUTFITS for Scientific Expeditions and Special Research.

Catalogues and Estimates free on application.

Lenses, Kinematographs, Lanterns, and all Photographic Accessories and Materials.

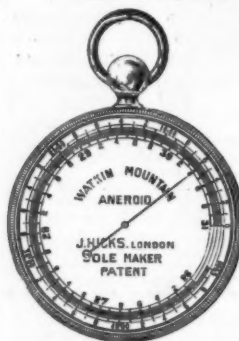
NEWMAN & GUARDIA, Ltd.,
90 & 92 Shaftesbury Avenue, London, W.

JAS. J. HICKS, 8, 9 & 10 HATTON GARDEN, LONDON, SCIENTIFIC INSTRUMENT MAKER

TO THE
WAR OFFICE, INDIA OFFICE, ADMIRALTY, &c.,

IS SOLE MAKER OF THE
NEW PATENT

"WATKIN"
MOUNTAIN ANEROID
BAROMETER.



The Barometer that all the World has been waiting for, and the only Aneroid that can be thrown in and out of action as required, and which, when out of action, is absolutely impervious to the influence of variations in atmospheric pressure. Travellers and Surveyors will now be able to ascertain correct altitudes owing to the marvellous accuracy of this Instrument, which is described at length by Mr. WHYMFER, the distinguished Alpine climber, in the "Times" of Dec. 17, 1898. In 65 readings taken between 1227 and 10,289 feet above the sea, the mean error ascertained by comparison

says: "Extraordinary results may be obtained from Watkin's Mountain Aneroid in observations made for altitude, and in determining differences of level."

"It is beyond doubt a wonderful instrument," &c. (Press).

It is made in Aluminium for lightness, in either 3-inch or 4½-inch sizes, with Sling Leather Case, and supplied at the following prices:—Scale to 5000 feet, £5 5s. To 10,000 feet, £5 10s. To 15,000 feet, £5 15s. To 20,000 feet, £6.

N.B.—Orders will be executed for this Instrument strictly in the rotation in which they are received.

Full particulars on application.

OPPOSITE THE BRITISH MUSEUM.

THACKERAY HOTEL

(TEMPERANCE),

GREAT RUSSELL STREET, LONDON.

THIS newly-erected and commodious Hotel will, it is believed, meet the requirements of those who desire all the conveniences and advantages of the larger modern licensed hotels at moderate charges. Passenger Lift. Electric Light in all Rooms. Bath-rooms in every Floor. Spacious Dining, Drawing, Writing, Reading, and Smoking Rooms. All Floors Fireproof. Perfect Sanitation. Night Porter. Telephone. Bedrooms from 2s. 6d. to 4s. 6d. per night. Full Tariff and Testimonials on application.

Telegraphic Address: "THACKERAY, LONDON."

Proprietor—J. TRUSLOVE.

Also, amalgamated with, and under the same management,

ESMOND HOTEL

(TEMPERANCE),

MONTAGUE STREET, RUSSELL SQUARE.

THIS Hotel, which has been carried on so successfully for the last 13 years, adjoins the British Museum, and is exceptionally quiet. Bedrooms from 2s. to 3s. 6d. per night. Full Tariff and Testimonials on application.

Telegraphic Address: "TRUSLOVE, LONDON."

Proprietor—J. TRUSLOVE.

THE SCIENTIFIC MAN'S, NATURALIST'S, AND TRAVELLER'S CAMERA IS THE

Stereoscopic Company's BINOCULAR,

Because when ready to take 12 Pictures it weighs 19 ounces only.

It is used like a Field Glass. Takes instantaneous and time exposures. Gives Pictures 7 in. by 5 in. when used with the simple printing and enlarging apparatus. Price £5 5s. only. Complete with enlarging apparatus, £10 10s. Also made in larger sizes. **FREE Lessons to Purchasers.**

From R. BOWDLER SHARPE, Esq., LL.D., Assistant Keeper, Zoological Department, British Museum.

"I have received the remainder of the proofs of my photographs, and I must say that I am delighted with them. I consider it one of the best day's work I ever did when I bought one of your 'Binocular' Cameras. The ease with which it is worked, and the excellent results obtained, make it a most pleasurable accompaniment of a summer's outing, and, in my case, 90 per cent. of my Norway photographs have come out beautifully, while even the small remainder cannot be considered failures. I think this is a grand result, when you remember that I had little or no experience of photography, and had only time for an hour's instruction in your rooms the day before I sailed, and, further, that I had to make my own dark rooms in Norway in the best way I could. I am looking forward to having much pleasure this summer from the faithful 'Binocular,' and I have recommended it to all my friends."

THE STEREOSCOPIC COMPANY,

108 and 108 REGENT STREET, W., and 54 CHEAPSIDE, E.C.



CATALOGUES FREE.

INDEX NUMBER.



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 1572, VOL. 61]

THURSDAY, DECEMBER 14, 1899.

PRICE ONE SHILLING

Registered as a Newspaper at the General Post Office.]

[All Rights are Reserved.



NEWTON'S PATENT
Scientist's Biunial Lantern,
AS MADE FOR
Oxford and London University
Extension Lecturers, &c.
Highest quality only, £14 14s.
*New Catalogue of Optical Lanterns,
Projection Apparatus, and Scientific
and other Slides, Four Stamps.*

NEWTON & CO.,
*Opticians to the Queen and
the Government,*
3 FLEET STREET, LONDON.

BECK'S
NEW
MICROSCOPE
THE
"BRITISH STUDENTS."

Microscope Stand No. 65, as
figured, with Iris Diaphragm,
One Eye-piece; Double Nose-
piece, Two Object-glasses, 2/3"
and 1/8", adjusted to be in
about focus, and the whole
packed in polished Mahogany
Case,

£6 : 8 : 6

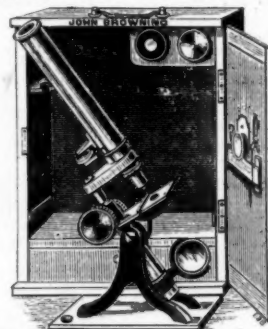


No. 55.

R. & J. BECK, Ltd.,
68 CORNHILL, LONDON, E.C.

BROWNING'S

"PERFECT"



MICROSCOPE.

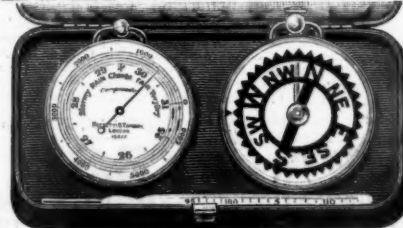
The body is made entirely of brass and gun-metal, with rack-motion and fine
screw adjustment. Three achromatic powers (separable) of excellent defining
power, 1-inch, 1/2-inch, and 1/4-inch; adjusting slide-holder to stage, revolving
diaphragm, hand-forceps, stage-forceps, live-cage, &c. The whole packed
in upright Mahogany Cabinet, with drawer for slides, dissecting-knives, &c.

PRICE £3 15s. 0d.

New Illustrated Catalogue of Microscopes free.

JOHN BROWNING, 63 STRAND, LONDON, W.C.

CHRISTMAS PRESENTS



NEGRETTI & ZAMBRA'S
TRAVELLER'S SCIENTIFIC COMPANION.

Aneroid Barometer with Altitude Scale, Compass with Patent Dial and
Thermometer for Air Temperatures (or a Clinical Thermometer may be
substituted). An excellent Present for Officers on Foreign Service.

PRICE £4 10s. to £7 10s.

Can also be had Mounted in either Gold or Silver Cases.
"Special" Illustrated Price List of Instruments, suitable for
Presents, free by Post to all parts of the World.

NEGRETTI & ZAMBRA,
SCIENTIFIC INSTRUMENT MAKERS TO THE QUEEN,
38 HOLBORN VIADUCT, E.C.
BRANCHES—45 CORNHILL; and 122 REGENT STREET.

ROYAL INSTITUTION OF GREAT BRITAIN.

ALBEMARLE STREET, PICCADILLY, W.
LECTURE ARRANGEMENTS BEFORE EASTER, 1900.

LECTURE HOUR, 3 O'CLOCK P.M.

CHRISTMAS LECTURES.

CHARLES VERNON BOYS, Esq., F.R.S., M.R.I. Six Lectures (adapted to a Juvenile Auditory) on "Fluids in Motion and at Rest," Experimentally Illustrated. On Dec. 28 (Thursday), Dec. 30, 1899, Jan. 2, 4, 6, 9, 1900. One Guinea the Course; Children under 16, Half-a-Guinea.

PROF. E. RAY LANKESTER, M.A., LL.D., F.R.S., Director of the Natural History Departments of the British Museum, Fullerian Professor of Physiology, R.I. Twelve Lectures on "The Structure and Classification of Fishes." On Tuesdays, Jan. 16, 23, 30, Feb. 6, 13, 20, 27, March, 6, 13, 20, 27, April 3. One Guinea the Course.

W. H. R. RIVERS, Esq., M.A., M.D., F.R.C.P. Three Lectures on "The Senses of Primitive Man." On Thursdays, Jan. 18, 25, Feb. 1. Half-a-Guinea.

PROF. H. H. TURNER, M.A., F.R.S., Savilian Professor of Astronomy in the University of Oxford. Three Lectures on "Modern Astronomy." On Thursdays, Feb. 8, 15, 22. Half-a-Guinea.

CHARLES WALSTEIN, Esq., LL.D., Ph.D., L.H.D., Slade Professor of Fine Art, University of Cambridge. Three Lectures on "Recent Excavations at the Argive Heraeum (in Greece)." (Illustrated by Lantern Slides). On Thursdays, March 1, 8, 15. Half-a-Guinea.

Three Lectures on Thursdays, March 22, 29, April 5. Half-a-Guinea.

SIR HUBERT H. PARRY, Mus. Doc., M.A., D.C.L., Director of the Royal College of Music. Three Lectures on "Neglected By-ways in Music (with Musical Illustrations). On Saturdays, Jan. 20, 27, Feb. 3. Half-a-Guinea.

W. L. COURTNEY, Esq., M.A., LL.D. Three Lectures on "The Idea of Tragedy in Ancient and in Modern Drama." On Saturdays, Feb. 10, 17, 24. Half-a-Guinea.

THE RIGHT HON. LORD RAYLEIGH, M.A., D.C.L., LL.D., F.R.S., M.R.I., Professor of Natural Philosophy, R.I. Six Lectures on "Polarised Light." On Saturdays, March 3, 10, 17, 24, 31, April 7. One Guinea.

Subscription (to Non-Members) to all Courses of Lectures (extending from Christmas to Midsummer), Two Guineas. Tickets issued daily at the Institution, or sent by post on receipt of Cheque or Post-Office Order.

Members may purchase not less than Three Single Lecture Tickets, available for any Afternoon Lecture, for Half-a-Guinea.

The FRIDAY EVENING MEETINGS will begin on January 19th, at 9 p.m., when the Right Hon. LORD RAYLEIGH will give a Discourse on "Flight." Succeeding Discourses will probably be given by the Hon. CHARLES A. PARSONS, Prof. J. REYNOLDS GREEN, H. WARINGTON SMYTH, Esq., Prof. JOHN H. POYNTING, Major RONALD ROSS, Prof. FRANK CLOWES, Sir BENJAMIN STONE, M.P., Sir ANDREW NOBLE, K.C.B., Prof. J. ARTHUR THOMSON, Prof. DEWAR, and other Gentlemen. To these Meetings Members and their Friends only are admitted.

Persons desirous of becoming Members are requested to apply to the SECRETARY. When proposed they are immediately admitted to all the Lectures, to the Friday Evening Meetings, and to the Library and Reading Rooms; and their Families are admitted to the Lectures at a reduced charge. Payment: First Year, Ten Guineas; afterwards, Five Guineas a Year, or a composition of Sixty Guineas.

UNIVERSITY COLLEGE, LONDON.

SPECTROSCOPY AND SPECTRUM PHOTOGRAPHY.

By E. C. C. BALY.

A Course of Eight Lectures dealing with the methods of Spectroscopy especially in connection with the Photography of the Spectrum will be given on Friday Evenings at 5.30 o'clock, commencing on January 19, 1900.

The following subjects will be treated and illustrated by experiments:—Refraction and Diffraction.—The Prism Spectroscope.—The Comparison of Spectra and Determination of Wave Lengths.—The Grating Spectroscope.—Concave Gratings; their Mounting and Adjustment.—Wave Length Determination with the Grating.—Photography of the Spectrum.—Methods of Producing Spectra.—Fluorescence and Phosphorescence. Fee for the Course, £1 1s.

J. M. HORSBURGH, M.A., Secretary.

B.A. AND B.Sc.

MATRICULATION, INTERMEDIATE, FINAL.

PREPARATION BY CORRESPONDENCE AND ORAL TUITION on a THOROUGHLY INDIVIDUAL SYSTEM. Fees based on success.

The STAFF includes Graduates of Oxford, Cambridge, London, and Royal Universities, Science Medalists, Prizemen, Scholars, &c.

SINGLE SUBJECTS TAKEN: Latin, Greek, French, German, Mathematics, Science, Logic, Psychology, Political Economy, &c. For Terms, &c., address Mr. J. CHARLESTON B.A. (London and Oxon.), The Burlington Classes, 27 Chancery Lane, London, W.C.

SCIENCE EXAMINATIONS.

For LONDON and other UNIVERSITIES, the CONJOINT BOARD, &c.

Well-equipped LABORATORIES, DAY AND EVENING. Personal or Class Tuition.

"R." 9 Heathcote Street, Gray's Inn Road, W.C.

BIRKBECK INSTITUTION,

Breams Buildings, Chancery Lane, E.C.

Science Classes with Practical Work.

DAY AND EVENING CLASSES for University of London B.Sc.; Prelim. Scientific, Inter. M.B. Examinations and for Conjoint Board, Dental and Pharmaceutical Examinations.

EVENING CLASSES in all stages for Science and Art Department Examinations.

HIGHLY-EQUIPPED LABORATORIES.

Chemistry, Physics, Biology (Zoology and Botany), Metallurgy, Geology and Mineralogy, Microscopy.

Prospectus free. Calendar 6d. (Post 8d.) on application to Secretary.

BACTERIOLOGY.

BACTERIOLOGICAL DEPARTMENT, KING'S COLLEGE, LONDON.

Director: PROF. CROOKSHANK.

The Laboratories are open daily for Instruction and Research from 10 a.m. to 5 p.m. For Syllabus of Classes apply THE SECRETARY.

For Information and Advice as to the Course of Instruction to be selected, application must be made in writing to PROF. CROOKSHANK, or an interview may be obtained by appointment.

SPECIAL CLASSES IN JANUARY.

Two complete Courses of Practical Instruction for Medical Practitioners, Veterinary Surgeons, Analysts, &c., will commence on January 8th.

Demonstrations to the Morning Class (Dr. NEWMAN, D.P.H.) will be given at 11 a.m., and to the Afternoon Class (Dr. NASH, D.P.H.) will be given at 2 p.m.; three days a week, with practical work daily in the Laboratory for THIRTY DAYS.

A Class for Candidates for the D.P.H. (Bacteriology) will commence on January 8th at 10 a.m., and a Time Table arranged to suit the convenience of the Class.

A Class in Clinical Bacteriology, consisting of Demonstrations with practical work, will commence on Wednesday, January 10th (2 to 3.30), and be held on successive Wednesdays for six weeks.

THE LONDON SCHOOL OF TROPICAL MEDICINE

(UNDER THE AUSPICES OF HER MAJESTY'S GOVERNMENT),
CONNAUGHT ROAD, ALBERT DOCK, E.

IN CONNECTION WITH THE HOSPITALS OF THE SEAMEN'S HOSPITAL SOCIETY.

The next SESSION commences on MONDAY, JANUARY 15, 1900. A Travelling Scholarship of £300 will be offered to Students of the School. The Laboratories, Museum, Library, &c., are open daily. Lectures on Tropical Medicine, Tropical Hygiene and Surgery in the Tropics, are delivered during the Session.

Clinical Instruction is given daily in the wards of the Hospitals. Special arrangements for Board will be made for those who may desire to reside on the premises.

For Prospectus, Syllabus, and other particulars, apply to the Secretary, P. MICHELLI, Esq., Seamen's Hospital, Greenwich, S.E.

LIVERPOOL SCHOOL OF TROPICAL MEDICINE

IN CONNECTION WITH

UNIVERSITY COLLEGE AND ROYAL SOUTHERN HOSPITAL.

Lecturer ... MAJOR ROSS, late I.M.S.

For prospectus and all particulars, apply to A. H. MILNE, B.A., Hon. Sec., Chamber of Commerce, Liverpool.

Telegrams—"Tunzelmann, London."

THE GENERAL ENGINEERING COMPANY, LTD.,

2 and 4 PENYWERN ROAD, LONDON, S.W.

G. W. DE TUNZELMANN, Managing Director.

Mechanical, Electrical and Chemical Patents experimentally developed and Models constructed for Inventors. Special Machinery and Apparatus designed and carried out to Specification. Every description of Accurate work. Repetition work with all parts interchangeable.

EXPERIMENTAL WORKS, BATH.—

Facilities for conducting Scientific and Mechanical Investigations. Pupil taken. Seventy acres of ground.—Apply to MANAGER.

H. J. GLAISHER'S NEW BOOKS.

Nearly Ready, Demy 8vo, Price 7s. 6d. net; by Post 7s. 10d.
THE LETTSOMIAN LECTURES ON GRANULAR KIDNEY. By SAMUEL WEST, M.D., F.R.C.P., Senior Physician, Royal Free Hospital; Asst. Physician, St. Bartholomew's Hospital.

Demy 8vo, Cloth, Price 5s. net; by Post 5s. 4d.
CLINICAL LECTURES ON NEURASTHENIA. Comprising a complete Account of its Symptoms, Pathology and Treatment. By THOMAS D. SAVILL, M.D.

Now Ready, Crown 8vo, Cloth, Price 2s. net; by Post 2s. 3d.
CANCER, Illustrated by 1000 Cases from the Registers of the Middlesex Hospital and by 50 Selected Cases of Cancer of the Breast, &c., &c. By T. W. NUNN, F.R.C.S. With Plates of Microscopical Sections.

Ready Shortly.
STUDIES IN HUMAN AND COMPARATIVE PATHOLOGY. By WOODS HUTCHINSON, A.M., M.D., Professor of Comparative Pathology, University of Buffalo, Medical Department.

Nearly Ready, Sewed, Crown 8vo, Price 1s. 6d. net; by Post 1s. 8d.
CONSUMPTION: ITS NATURE AND TREATMENT. By WILLIAM H. SPENCER, M.A., M.D. Cantab., M.R.C.P. Lond., Consulting Physician to the Bristol Royal Infirmary; formerly Lecturer on the Principles and Practice of Medicine, and on Pathology, at University College, Bristol, Medical School.

Second Edition, Royal 8vo, Cloth, Price 3s. 6d. net; by Post 3s. 10d.
ON THE STUDY OF THE HAND FOR INDICATIONS OF LOCAL AND GENERAL DISEASE. By EDWARD BLAKE, M.D., M.R.C.S. Rewritten and much Enlarged, including a New Section on the Pulse—Chloroform Syncope, a New Treatment on purely scientific lines—the immediate cure of Engorged Liver. 36 Illustrations.

H. J. GLAISHER,
 57 WIGMORE STREET, LONDON, W.

HEATHCOTE SCIENCE LABORATORIES.

These Laboratories are open for RESEARCH work, at any hours or times most convenient for worker, in **CHEMISTRY, PHYSICS** and **BACTERIOLOGY.** Facilities for Commercial investigations are supplied. Furnaces and powerful Electrical Currents can be used.

The Fees are at rate of £3 3s. for one month (five days a week, six hours a day). Apparatus supplied free.

Private Laboratory, £4 14s. 6d. a month, or by arrangement. The above Fees include use of all ordinary Glass and other Apparatus, and use of Accurate Balances and Standard General Instruments, also Furnaces, &c.

9 Heathcote Street, Mecklenburgh Square,
 Gray's Inn Road, W.C.

R. C. T. EVANS,
 Director.

Required shortly in a Scientific Department in the Colonies, a capable **TECHNICAL ASSISTANT.** Age 25 to 35. Qualifications: Preferably a Graduate in Natural Science Honours; well informed in current Scientific work, chiefly Biological; proficient in French and German; and with good experience in correcting and editing papers for the press—latter essential. Salary, £300 to £400, according to experience, with a First Class Passage.—Address, stating full particulars, to Mr. HARRIES, 63 Victoria Street, S.W.

WANTED, at an early Date, a Technical ASSISTANT.—Preference will be given to a Graduate in Natural Science Honours, well informed in Current Scientific Work, chiefly Biology. Proficient in French and German, and with good experience in correcting and editing papers for the Press. Salary offered up to £400 per Annum. Apply in the first instance to Messrs. GABBITAS, THRING & Co., 36 Sackville Street, London, W.

Sale by Auction.

TUESDAY NEXT, DECEMBER 19.

COLLECTION OF BRITISH LEPIDOPTERA, HEADS AND HORNS OF ANIMALS, CURIOS, &c.

MR. J. C. STEVENS will Sell by Auction, at his Great Rooms, 38 King Street, Covent Garden, on Tuesday next, December 19, Collection of British Lepidoptera formed by G. LOVELL KEAYS, Esq., and several small Collections of Lepidoptera and Coleoptera from German East Africa, and a very fine Collection of Heads and Horns of Animals, Skulls, Birdskins, Cabinets, &c., and various Natural History Specimens.

On View day prior, from 10 till 4, and morning of Sale, and Catalogues had.

R. FRIEDLÄNDER & SOHN,
PUBLISHERS,

BERLIN (GERMANY), N.W., CARLSTRASSE 11.

Now Ready.

E. L. TROUESSART.
**CATALOGUS MAMMALIUM,
 TAM VIVENTIUM QUAM FOSSILIIUM.**

2 Volumina: xvi. et 1469 pg., roy. 8, 1897-99.

Price £3 6s. net.

A. B. MEYER and L. W. WIGLESWORTH.
**THE BIRDS OF CELEBES
 AND THE NEIGHBOURING ISLANDS.**

2 Volumes in Imperial Quarto.

xxxii., 130 and 962 pages of Text, with 7 Coloured Maps and 45 Plates, of which 42 (Figures of 77 Species) are carefully coloured, 1898.

Price £12 net.

Prospectus with Specimen Plate and Reviews sent on application.

After receipt of Price, these Works are sent Carriage Free.

WHITTAKER'S NEW BOOKS.

OPTICAL ACTIVITY AND CHEMICAL COMPOSITION. By Dr. H. LANDOLT, Professor of Chemistry in the University of Berlin. Translated by J. McCRAE, Ph.D. Crown 8vo, Cloth, 4s. 6d.

OUTLINES OF PHYSICAL CHEMISTRY. By A. REYCHLER, Professor à l'Université Libre de Bruxelles. Translated by J. McCRAE, Ph.D., Demonstrator of Chemistry in the Yorkshire College, Leeds. With 52 Illustrations. Crown 8vo, Cloth, 4s. 6d.

"We heartily commend this book to all students of chemistry."—*Practical Teacher.*

ELEMENTARY PRACTICAL CHEMISTRY FOR STUDENTS IN SCIENCE SCHOOLS. By A. J. COOPER, B.Sc., Principal of the Harris Institute, Preston. Crown 8vo, 2s.

VOLUMETRIC CHEMICAL ANALYSIS. FOR THE SCIENCE AND ART DEPARTMENT AND LONDON UNIVERSITY EXAMINATIONS. By J. B. COPPOCK, Lecturer in Chemistry, Bath Technical School. Crown 8vo, 2s.

MAGNETISM AND ELECTRICITY, AN ELEMENTARY COURSE OF PRACTICAL EXERCISES IN. By J. R. ASHWORTH, B.Sc., F.Phys.Soc., Lecturer in Physics, Rochdale Municipal Technical School. Second Edition, Revised. Crown 8vo, 2s. 6d.

ORGANIC CHEMICAL MANIPULATION. By J. T. HEWITT, M.A., D.Sc., Ph.D., F.C.S., Professor of Chemistry in the East London Technical College. With 63 Illustrations. Crown 8vo, 4s. 6d.

"The work will be of great service to many teachers of practical chemistry."—*Engineer.*

London: WHITTAKER & CO.,
 2 WHITE HART STREET, PATERNOSTER SQUARE.

WEBSTER'S INTERNATIONAL DICTIONARY OF THE ENGLISH LANGUAGE.

One Volume, Cloth, £1 11s. 6d.

**A PRACTICAL, HANDSOME AND CHEAP XMAS PRESENT
FOR THE MAN OF SCIENCE AND THE MAN OF AFFAIRS.**

It excels in the ease with which the eye finds the word sought; in accuracy of definition; in effective methods of indicating pronunciation; and in terse and comprehensive statements of fact.

WEBSTER'S DICTIONARY has been so long and so well known that it seems superfluous to say much as to its great merits and practical usefulness. In order that the book may continue to deserve its success every pains have been taken to keep it thoroughly abreast with modern scholarship.

In the year 1891 was issued the Third Edition, which can fairly claim to be practically a new book. This edition was reprinted with corrections in 1892 and 1894, and was revised in 1897. Its vast superiority over former editions is attested by the following facts:—

The whole work has been reset in new type from beginning to end. The preceding edition, with all its supplementary matter, has been re-studied **line by line**.

A close comparison has been made with a whole library of the most recent works on **philology** and all branches of knowledge that include new usages of speech.

Upon **technical** subjects specialists have been employed, and their contributions have been carefully harmonised in form with the general principles of the revision.

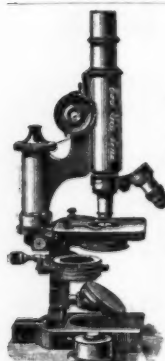
Great care has been devoted to the **illustrations**; the number has been increased from **3000** to nearly **4000**, and about two-thirds of them are entirely new.

THE ATHENÆUM.—" . . . The publication of this volume of 2118 pages ought to be regarded with gratitude as a remarkable and beneficent achievement."

This Dictionary is issued in one or two volumes, bound in various styles, at prices ranging from **£1 11s. 6d.** to **£3 15s.** The Half-Calf Binding, price **£2 2s.**, is strongly recommended.

On receipt of a Postcard mentioning **NATURE**, a detailed Prospectus will be sent Post free.

LONDON: GEORGE BELL & SONS, YORK STREET, COVENT GARDEN.



CARL ZEISS,

(OPTICAL WORKS, JENA.)

LONDON BRANCH:

29 MARGARET STREET, REGENT STREET, W.

MICROSCOPES and ACCESSORIES
—For Bacteriology, Biology, Mineralogy and Student's use. — Apochromatic, Achromatic Objectives.—Micrometers, &c.

OPTICAL MEASURING INSTRUMENTS.—Spherometers, New Crystal Refractometer, Butter-Refractometer for the rapid determination of the purity of Butter, Lard, and Glycerine.

NOTE.—We do not make Theodolites.

Illustrated Catalogues, including new edition (1898) of Catalogue of Microscopes, free. Please state which required.

CHEAP SPECTROSCOPES

(a) **STUDENT'S SPECTROSCOPE**; comprising a Prism of Dense Flint, Telescope and Collimator with $7\frac{1}{2}$ " Focus Achromatic Object Glasses, Circle divided over 90° to $5'$ of Arc, Slit with Non-corrosive Jaws and Screw Adjustment. Mounted on Strong Iron Tripod.

Price £5 0 0

(b) **STUDENT'S SPECTROSCOPE**; do., do., with 9" Object Glasses. Also Rotating Prism Table, and Tilting Adjustments to Telescope and Collimator.

Price £6 10 0

(c) **SOUTH KENSINGTON TYPE TABLE SPECTROSCOPE**; comprising Prism of Dense Flint $1\frac{1}{2}$ " high by $1\frac{1}{2}$ " length of Face, Telescope and Collimator with $1\frac{1}{2}$ " clear Aperture, and $1\frac{1}{2}$ " Focus Achromatic Object Glasses, Circle divided all round to read to $1'$ of Arc, slit with Non-corrosive Jaws and Screw Adjustment, Comparison Prism, Wedge for reducing the Aperture, and divided Drumhead to Screw Adjustment. Telescope has slow motion by Tangent Screw. The Prism Table rotates, and there are Tilting Adjustments to Telescope and Collimator.

Price £8 0 0

ADAM HILGER, 204 Stanhope St., London, N.W.

X-RAY & ÆTHERIC TELEGRAPHY APPARATUS



See "Notes"
in NATURE
OF
Sept. 14, 1899.

OF THE HIGHEST QUALITY AND FINISH ONLY.

As supplied by us to H.M. Government and the leading Hospitals and X-Ray Workers throughout the World.

We are the actual Manufacturers, and Guarantee every Coil against breaking down.

CALL OR WRITE FOR OUR NEW ILLUSTRATED LIST, WITH TESTIMONIALS AND ILLUSTRATED INSTRUCTIONS UPON HOW TO WORK. POST FREE TO READERS OF "NATURE."

HARRY W. COX, Ltd.,
10, 11, 28 CURSITOR STREET,
CHANCERY LANE, LONDON.

Radiographs taken for Scientific and Medical Men, and Demonstrations given.

WALTER SCOTT'S LIST. THE CONTEMPORARY SCIENCE SERIES.

NEW VOLUMES.

Crown 8vo, Cloth, Price 6s. With Illustrations.

THE HISTORY OF THE EUROPEAN FAUNA.

By R. F. SCHARFF, B.Sc., Ph.D., F.Z.S.

Deals with the distribution of animals in Europe, and the geological conditions which have effected that distribution. The author endeavours to show the nature of the various migrations by which the different groups of animals have reached Europe, and especially Great Britain.

Crown 8vo, Cloth, Price 6s. With about 200 Illustrations.

THE RACES OF MAN: a Sketch of Ethnography and Anthropology.

By J. DENIKER.

This important volume attempts to present a summary of all the facts of anthropology in the light of the latest investigations. The first part of the book describes the physical and psychic characteristics of man throughout the world and in every stage of civilisation, while the last part discusses the races into which mankind may be divided.

Crown 8vo, Cloth, Price 6s. With Diagrams.

THE PSYCHOLOGY OF RELIGION.

By Prof. STARBUCK, Stanford University, California.

With an Introduction by Prof. WILLIAM JAMES, of Harvard University.

The author of this book deals for the first time in a scientific (though sympathetic) manner with the facts of religious life. He shows that conversion and the other stages of religious development may be brought into line with the biological facts of life. His work is founded on precise information derived from a large number of people, and is of special interest to teachers and ministers of religion.

London: WALTER SCOTT, LTD., Paternoster Square, E.C.

Just Published. With 121 Illustrations. Crown 8vo, 2s. 6d.

A PRACTICAL INTRODUCTION TO THE STUDY OF BOTANY: FLOWERING PLANTS.

By J. BRETLAND FARMER, M.A.,

Professor of Botany in the Royal College of Science, London; formerly Fellow of Magdalen College, Oxford.

LONDON: LONGMANS, GREEN, & CO.

Now Ready, Part IX., Vol. II., with 18 Plates. Text Medium 8vo: Plates Demy 4to. Price 18s.

LAND AND FRESH WATER MOLLUSCA OF INDIA.

This part treats more especially with the anatomy of species belonging to the Genera and Subgenera *Bensonia*, *Macrochlamys*, *Girasia*, *Austenia*, *Mariella*, *Ariophanta*, *Nilgilia*, *Euplecta*, *Ratnadvipia*, nov., *Eurychlamys*, nov., *Microcystina*, *Microcystis*?, *Haughtonia*, nov., and *Khasiella*, nov., with Notes on other Indian Species in other Genera. By Lieut.-Colonel H. H. GODWIN-AUSTEN, F.R.S., F.Z.S., &c.

Published by R. H. PORTER, 7 Princes Street, Cavendish Square, London, W.

LATEST PUBLICATIONS OF THE ZOOLOGICAL SOCIETY OF LONDON.

THE ZOOLOGICAL RECORD, Vol. 35.

Being Records of Zoological Literature relating chiefly to the Year 1898. Edited (for the Zoological Society of London) by D. SHARP, M.A., F.R.S., F.Z.S., &c. London, 1899. 8vo. Price 30s. To be obtained at the Society's Office (3 Hanover Square, W.), or through any Bookseller.

ALBERT EDWARD JAMRACH

(Late CHARLES JAMRACH),

NATURALIST,

180 ST. GEORGE STREET EAST.

Implements of Savage Warfare, Idols, Sacred Masks, Peruvian Pottery, Netsukis China, Lacquers, Gongs, Shells, and other Curios.

STANFORD'S COMPENDIUM OF GEOGRAPHY AND TRAVEL.

RE-ISSUE, REVISED, AND IN GREAT PART REWRITTEN, WITH NEW ILLUSTRATIONS AND MAPS. 12 VOLS.

Large Crown 8vo, Cloth, price 15s. each.

"The new issue of 'Stanford's Compendium of Geography and Travel' is a publication of great value, and contains, in convenient form, the latest geographical results of travel and research adequately treated. Not only is the information accurate, but the form in which the work is produced is admirable, and English geography may be proud of such a series. It is useful for educational purposes and for reference, and pleasant to the general reader."—*Athenaeum*.

JUST PUBLISHED. Large Crown 8vo, Cloth, 15s.

EUROPE, Vol. I.

THE COUNTRIES OF THE MAINLAND

(Excluding the North-West).

By GEORGE G. CHISHOLM, M.A., B.Sc.

With 32 Maps, and over 100 Illustrations.

The Volumes of the Re-issue already published are:

ASIA.—Vol. I. NORTHERN and **EASTERN ASIA, CAUCASIA, RUSSIAN TURKES- TAN, SIBERIA, CHINESE EMPIRE, and JAPAN.** By A. H. KEANE, F.R.G.S. With 8 Maps and 91 Illustrations.

ASIA.—Vol. II. SOUTHERN and **WESTERN ASIA, AFGHANISTAN, INDIA, INDO-CHINA, MALAY PENINSULA, TURKEY in ASIA, ARABIA, and PERSIA.** By A. H. KEANE, F.R.G.S. With 7 Maps and 89 Illustrations.

AUSTRALASIA.—Vol. I. AUSTRALIA and **NEW ZEALAND.** By ALFRED RUSSEL WALLACE, LL.D., D.C.L., F.R.S. With numerous Maps and Illustrations.

AUSTRALASIA.—Vol. II. MALAYSIA and the **PACIFIC ARCHIPELAGOES.** By F. H. H. GUILLE- MARD, M.D., Author of "The Cruise of the *Marchesa*." With numerous Maps and Illustrations.

AFRICA.—Vol. I. NORTH AFRICA. By A. H. KEANE, F.R.G.S., Author of "Asia" in the same Series, "Eastern Geography," &c. With 9 Maps and 77 Illustrations.

AFRICA.—Vol. II. SOUTH AFRICA. By A. H. KEANE, F.R.G.S., Author of "North Africa" in the same Series, "Eastern Geography," &c. With 11 Maps and 92 Illustrations.

NORTH AMERICA.—Vol. I. CANADA and **NEWFOUNDLAND.** By SAMUEL EDWARD DAWSON, Litt.D. (Laval), F.R.S.C. With 18 Maps and 90 Illustrations.

NORTH AMERICA.—Vol. II. THE UNITED STATES. By HENRY GANNETT, Chief Geographer of the United States Geological Survey. With 16 Maps and 72 Illustrations.

"EUROPE," Vol. II, and "SOUTH and CENTRAL AMERICA" are in active preparation.

Just Ready. Large Post 8vo, Cloth, 6s.

THE EVOLUTION OF GEOGRAPHY.

A Sketch of the Rise and Progress of Geographical Knowledge from the Earliest Times to the First Circumnavigation of the Globe.

By JOHN KEANE.

With 19 Maps and 7 Illustrations.

"A short but remarkably comprehensive, well-written, and interesting sketch. . . . Could not well be more vividly and accurately presented."—*The Scotsman*.

London: EDWARD STANFORD,

26 and 27 Cockspur Street, Charing Cross, S.W.

Geographer to the Queen.

CHARLES GRIFFIN & COMPANY, LIMITED.

OUTLINES OF BACTERIOLOGY. A

Practical Handbook for Students. By Dr. L. H. THOINOT and E. J. MASSELIN, Médecin Vétérinaire. Translated and Adapted for English Use, with Additions, by Wm. ST. CLAIR SYMMERS, M.B. Aberd. With Illustrations, some in Colours. Pocket-size, Leather, 10s. 6d.

Crown 4to, with 36 Beautifully Coloured Plates, 18s.

ATLAS OF URINARY SEDIMENTS,

with Special Reference to their Clinical Significance. By Dr. H. RIEDER. Translated by F. C. MOORE, M.Sc. Edited and Annotated by SHERIDAN DELÉPINE, M.B., C.M. Edin.

"A success in every way. Most beautifully executed."—*Lancet*.

AMBULANCE (A MANUAL OF). B. J.

SCOTT RIDDELL, C.M., M.B., M.A., Assistant Surgeon, Aberdeen Royal Infirmary; Examiner to the St. John Ambulance Association. With numerous Illustrations. Fourth Edition. 4s.

"About as good as it could possibly be."—*Daily Chronicle*.

DAIRY CHEMISTRY FOR DAIRY

MANAGERS, CHEMISTS, and ANALYSTS: A Practical Handbook for Dairy Chemists and others having Control of Dairies. With numerous Tables, and 22 Illustrations. By H. DROOP RICHMOND, F.C.S., Chemist to the Aylesbury Dairy Company. Large 8vo, 16s.

LEAD AND SILVER (THE METAL-

LURGY OF). By HENRY F. COLLINS, Assoc. R.S.M., Assoc. M.Inst. C.E. In Two Volumes. Part I.—LEAD, with Sections on Smelting and Desilverisation, and on the Assay and Analysis of the materials involved. Now ready. Complete in itself, and sold separately. With Illustrations, Handsome Cloth, Price 16s.

"A clear, workmanlike, comprehensive exposition."—*Scotsman*.

ELECTRO - METALLURGY (A TREA-

TISE ON): The Plating, Depositing, Smelting, and Refining of Metals, and the Reproduction of Printing Surfaces and Art Work, &c. By WALTER G. McMILLAN, F.I.C., F.C.S. Second Edition. Revised and Enlarged. 10s. 6d.

"We recommend this manual to all interested in electrolytic processes."—*Nature*.

CHARLES GRIFFIN & Co., Ltd.,
EXETER STREET, STRAND, W.C.

THE BRIDGES-LEE PHOTO-THEODOLITE

The most perfect Instrument
invented for Survey Work in
Mountainous Districts, and for
Military or Rapid Surveys.

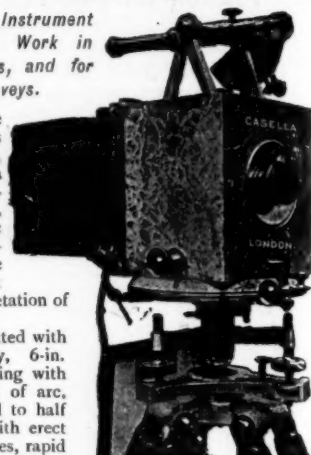
The Photo-Theodolite automatically records on the photograph all, or nearly all, the data necessary for the reduction of the photographs, including the Magnetic bearings, — thus considerably reducing the time spent and the risk of error in the interpretation of the photographs.

The Instrument is fitted with an Aluminium Body, 6-in. Azimuthal Circle, reading with Vernier to one minute of arc, 4-in. Compass, divided to half degrees. Telescope with erect and inverting Eye-pieces, rapid Rectilinear Lens with Iris Diaphragm and Colour Screen, six double dark Slides in Mahogany Case, with Stand complete, £45.

Descriptive Pamphlets and Illustrated Description of the Instrument sent free on application.

AGENT FOR RICHARD FRÈRES' AUTOMATIC RECORDING INSTRUMENTS.

L. CASELLA,
147 Holborn Bars, London, E.C.
Telegraphic Address: "Escutcheon, Lon. Ion." Telephone: Holborn 1054.

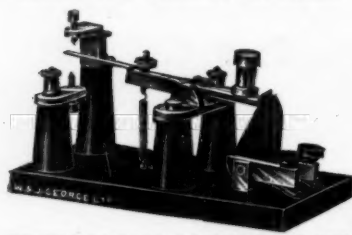


"NIVOC" SPECIALITIES.

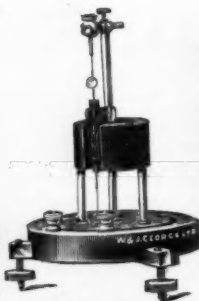
WORKS—BIRMINGHAM.

Buy direct from the Manufacturers.

THESE INSTRUMENTS ARE SPECIALLY
SUITED FOR WORKING TOGETHER.



KEMPE'S CHARGING & DISCHARGING KEY.
Improved Form with rubbing contacts, highly insulated, £3 15s. Highest quality and finish.
(Late F. E. BECKER & CO.)



"NIVOC" MOVING COIL GALVANOMETER
BALLISTIC, very sensitive. To work with $\frac{1}{2}$ Micro-Farad Condenser, £2 10s.



STANDARD CONDENSER, $\frac{1}{2}$ Micro-Farad, £2 12s. 6d.

STANDARD CLARK CELL, 25s. net

W. & J. GEORGE, LTD., 33-37 HATTON WALL, LONDON.

Second Volume.

A SELECTION OF PHOTOGRAPHS OF STARS, STAR CLUSTERS, AND NEBULÆ,

Together with Information concerning the Methods employed in the Pursuit of
Celestial Photography (Illustrated by 72 Photographs reproduced in Collotype),

By ISAAC ROBERTS, D.Sc., F.R.S.

Ready in December. Royal Quarto. Price 30s., post free.

LONDON: KNOWLEDGE OFFICE, 326 HIGH HOLBORN, W.C.

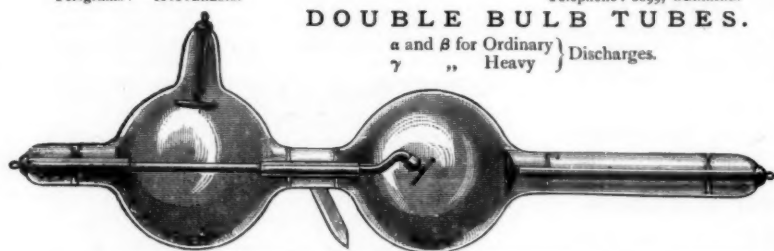
ISENTHAL, POTZLER & CO.,
85 MORTIMER STREET, LONDON, W.

Telegrams: "HYSTERESIS."

Telephone: 2099, GERRARD.

DOUBLE BULB TUBES.

α and β for Ordinary } Discharges.
" Heavy }



CENTRAL DEPOT FOR RADIOGRAPHERS.

Write for Lists, or better
inspect our Installations.

HIGHEST REFERENCES.
EVERYTHING NOVEL AND
ORIGINAL.

SOLE AGENTS FOR SCOTLAND:
Messrs. JAMES WHITE,
Cambridge St., Glasgow.

NEW SCIENCE LANTERN.



The Universal Science Lantern has been devised for the projection of experiments. In the short box in front of the lantern is a hinged mirror, so placed that by the movement of a stud it may be introduced and placed at an angle of 45 degrees with the parallel beam. The beam is thus sent upwards through a horizontal convergent lens, on which a slide or horizontal piece of apparatus can be placed. Above this is the objective mounted on a brass pillar, and above the objective a prism or mirror (if the screen is elevated above the lantern plain prisms are required for each beam), silvered on the outside so that there is no double reflection. The mirror can be adjusted to any angle, and is intended to send the image in an approximately horizontal direction to the screen. Slides can also be directly projected in the usual way.

The base-board is made to fold so that the lantern can be packed into a box 18½ x 8½ x 20½ with all its accessories *in situ*.

Price Complete, in Travelling Box, £9 0 0

REYNOLDS & BRANSON, LTD.
14 COMMERCIAL STREET, LEEDS.

QUARTZ FIBRES.

We are now making QUARTZ FIBRES about 40 cm. long, capable of supporting a weight of 50 grammes. These are especially suitable for suspending heavy magnets.

Price of Box containing 6 of these Fibres,
£1 0 0

FIBRES SUITABLE FOR GALVANOMETER SUSPENSIONS.

In Box containing 6 Fibres 16 cm. long	-	5	0
" " " 30 "	-	7	6
" " " 40 "	-	10	0

SCIENTIFIC INSTRUMENT CO.
LIMITED,
CAMBRIDGE.

WATKINS & DONCASTER,

**NATURALISTS,
AND MANUFACTURERS OF
CABINETS AND APPARATUS
FOR ENTOMOLOGY, BIRDS' EGGS, AND ALL BRANCHES OF
NATURAL HISTORY.**

SPECIAL SHOW-ROOM FOR CABINETS.

Call or send for detailed Catalogue (68 pp.), Post free on application.

N.B.—For Excellence and Superiority of Cabinets and Apparatus, references are permitted to distinguished patrons, Museums, Colleges, &c.

A LARGE STOCK OF INSECTS AND BIRDS' EGGS.

Birds, Mammals, &c., Preserved and Mounted by First-class Workmen with true natural surroundings. All Books and Publications on Natural History supplied.

36 STRAND, LONDON, W.C.
(Five Doors from Charing Cross.)

LIVING SPECIMENS FOR THE MICROSCOPE.

Volvox, Spirogyra, Desmids, Diatoms, Amœba, Arcella, Actinosphaerium, Vorticella, Stentor, Hydra, Floscularia, Stephanoceros, Melicerta, and many other Specimens of Pond Life. Price 1s. per Tube, Post Free. Helix pomatia, Astacus, Amphioxus, Rana, Anodon, &c., for Dissection purposes.

THOMAS BOLTON,

25 BALSALL HEATH ROAD, BIRMINGHAM.

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM.

THE LABORATORY, PLYMOUTH.

The following animals can always be supplied, either living or preserved by the best methods:—

Sycon; Clava, Obelia, Sertularia; Actinia, Tealia, Caryophyllia, Alcyonium; Horniphora (preserved); Leptopiana; Lineus, Amphiporus; Nereis, Aphrodite, Arenicola, Lanice, Terebella; Lepas, Balanus, Gammarus, Ligia Myia, Nebalia, Carcinus; Patella, Buccinum, Eledone, Pectens Bugula, Crisia, Pedicellina, Holothuria, Asterias, Echinus; Ascidia, Salpa (preserved), Scyllium, Raja, &c., &c.

For prices and more detailed lists apply to
Biological Laboratory, Plymouth.

THE DIRECTOR.

CO-OPERATIVE WORLD TRAVEL

Organised by HENRY S. LUNN, M.D., F.R.G.S.,
W. HOLDSWORTH LUNN, & CONNOP F. S. PEROWNE.

A Cruise to the WESTERN MEDITERRANEAN.

TILBURY, GIBRALTAR, TANGIER, ALGIERS, PALMA, VILLEFRANCHE (for NICE, CANNES, MONTE-CARLO), MARSEILLES.

A FIFTEEN DAYS' CRUISE FOR £9 9s. AND UPWARDS.

A Cruise to the EASTERN MEDITERRANEAN.

(Return ticket to MARSEILLES included.)

MARSEILLES, SYRACUSE, PIRÆUS (for Athens),
CONSTANTINOPLE, JAFFA (for Jerusalem), ALEXANDRIA,
MALTA, NAPLES, MARSEILLES.

A THIRTY-FIVE DAYS' CRUISE FOR £36 15s. AND UPWARDS
s.v. ARGONAUT. Tonnage, 3254; h.-p., 4000.

Full particulars from the Secretary, 5 Endsleigh Gardens,
Euston, London, N.W.

BORD'S PIANOS

BECHSTEIN PIANOS

25 per cent. Discount for Cash, or 14/6 per month (second-hand, 10/6 per month) on the Three Years' System. Lists free of

C. STILES & CO., 40 & 42 Southampton Row, London, W.C.
PIANOS EXCHANGED.

These magnificent Pianos for Hire on the Three Years' System at advantageous prices and terms. Lists and particulars free of
CHAS. STILES & CO., 40 & 42 Southampton Row,
LONDON, W.C.

MINERALS, FOSSILS, ROCKS.

COLLECTIONS OF THIN SLICES FOR PRACTICAL MICROSCOPIC PETROGRAPHICAL STUDY.

(a) Collections of Thin Slices of all important Rock-forming Minerals, for the Demonstration of the occurrence of the same in the Rocks, arranged according to F. Zirkel, "Lehrbuch der Petrographie," 2nd ed., Leipzig, 1893. Collection of 114, respectively, 60 Thin Slices.

Price, in elegant Case, £7; respectively, £3 15s.

(b) New Collection of properly mounted Thin Slices of Rock-forming Minerals, arranged according to H. Rosenbusch, "Microscopic Physiography of Minerals," 3rd. ed., Stuttgart, 1897.

120 Thin Sections of 67 different Minerals in elegant Case £9 0 0
50 " " " 34 " " " 3 10 0

(c) Collections of Thin Slices of Rocks, to which will be added a short printed description of all the Specimens and Slices, arranged according to H. Rosenbusch, "Microscopic Physiography of Rocks," 3rd. ed., Stuttgart, 1896.

Collection of ... 120 180 250 Thin Slices.

Price, in elegant Case, £7 10 0 £11 5 0 £16 5 0

THE NEW CATALOGUE OF MINERALS, METEORITES, &c., has just been published, and will be sent, Post free, on application,

Dr. F. KRANTZ,

BONN-ON-THE-RHINE, RHENISH MINERAL OFFICE

ESTABLISHED 1833.

(Represented by Messrs. HARRINGTON BROS., Oliver's Yard,
53A City Road, London, E.C.; and Cork, Ireland.)

MINERALS, ROCKS & FOSSILS.

COLLECTIONS FOR STUDENTS.

Carefully labelled and arranged in Boxes with Card Trays.

50 Minerals, 12/6; 100 do., 21/-; 200 do., 42/-.

Rocks and Fossils at similar prices.

300 Minerals in Cabinet, £4 4s.; 400 do., £5 12s. 6d.

Catalogues Post Free.

THOMAS D. RUSSELL,

78 NEWGATE STREET, LONDON, E.C.

MINERALS AND PRECIOUS STONES.

Mr. HENSON has now on hand a Fine Series of interesting Sapphires, also Topazes, Gold, and Barytes in Large Crystals of various Colours. Large and perfectly clear Rock Crystal Balls, precious Opal Cameos, Fluor Spar, Agate, Jasper, and other Stones cut for ornamental purposes.

LESSONS GIVEN.

SAMUEL HENSON,

97 REGENT STREET, LONDON, W.

ESTABLISHED 1840.

PHYSIOGRAPHY and GEOLOGY.

COLLECTIONS & MICROSCOPIC SLIDES,

As advised by Science and Art Directory, arranged by

JAMES R. GREGORY & CO.,

Mineralogists, &c.,

To Science and Art Department, British, Indian and Colonial
Museums, &c.

NOVELTIES and RARE GEMS and PRECIOUS STONES

Mineral Specimens for Museums, and Collectors, and all purposes.
Rock Specimens and Microscopic Sections of Rocks and Minerals
cut to order.

NEW AND VALUABLE MINERAL SPECIMENS CONSTANTLY
ARRIVING.

Stores & Offices: 1 Kelso Place, KENSINGTON, W.
NEW CATALOGUES and Lists FREE.

DE
V
Physi
30
STUD
BRI
Aggre
Guar
Plati
Pric
IMP
for
Galva
Reli
Hydro
suppl
Organ
PH
Apparatus or estimation of sulphur in spent oxide.
SC
Catalo
Catalo
GO
T
HUG
The M
See M
&c. M
success
Demon
Higher
TAN G
Scienc
Portrait
Lectur
Outfit
graving
Views
SPECIA

W. G. PYE & CO.

Physical & Physiological Instrument Makers,
30 ST. ANDREW'S STREET, CAMBRIDGE.

STUDENTS'

BRIDGE

Aggregate
Guaranteed
Platinoid



WHEATSTONE

BOX.

12,220 ohms
to 1 in 500.
Wire.

Price £9 10s., as illustrated. Smaller Boxes, from £3.

IMPROVED REFLECTING GALVANOMETER,

for use with above, any resistance to 2000 ohms, £3.

Galvanometer Shunts, Galvanometer Lamps and Scales, Keys, Single Coils, Batteries, &c.

Reliable Apparatus at low prices for teaching Mechanics, Hydrostatics, Heat, Optics, Magnetism and Electricity, as supplied to many of the leading Technical Institutes and Organised Science Schools.

Physical and Physiological List—Sixpence, Post free.

Apparatus or estimation of sulphur in spent oxide.



FREDK. JACKSON & Co.

(Late MOTTERSHED & CO.),
14 CROSS STREET, MANCHESTER.

Goods Entrance: 10 Half-Moon Street,

LABORATORY FURNISHERS,

Importers, Manufacturers, and Dealers in
CHEMICAL AND PHYSICAL
APPARATUS

Of every Description.

Fine Chemicals, Volumetric Solutions,
Plain and Stoppered Bottles,

AND EVERY LABORATORY REQUIREMENT.
Illustrated Catalogue of Apparatus, with Price List
of Chemicals, free on application.

Telegraphic Address—"APPARATUS, MANCHESTER."
Telephone Number—2038.

T. TAMBLYN-WATTS, SCIENTIFIC APPARATUS MAKER.

Catalogue of Electrical Apparatus and Materials, 6d. Post free.

Catalogue of Balances and Weights, Apparatus for the Study
of Mechanics, &c., 6d. Post free.

GOLDIELANDS, SETTLE, YORKS.

TO SCIENCE LECTURERS.

HUGHES' MOTO-PHOTOSCOPE FOR LIVING PICTURES.

THE MOST PERFECT.

NO SHUTTER, therefore no Flickering. Superb Mechanism.

The Moto-Photo Camera for taking the Pictures. Illustrated Lists, 2d.
See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN,
&c. Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great
success. New Oxyhydrogen Microscope. Science Lanterns for Glass
Demonstration. Magnificent Results. Docwra Triple, Prize Medal,
Highest Award. Supplied to the Royal Polytechnic Institution, Dr. H. GRAY-
TAN GUINNESS, Madame ADELINA PATTI, &c. Patent Pamphengos
Science Lanterns. The Universal Lantern 4-inch Condensers, 4-wick Lamp,
Portrait Combination front Lenses, 18s. 6d., Marvellous value. Science
Lecture Sets. Novelties. The Lantern Kaleidoscope. Cheapest Lantern
Outfits in the World. Grandly Illustrated Catalogue, over 150 choice En-
gravings, 6d.; Postage, 3d. List of 300 Lecture Sets, Science Subjects,
Views, &c., 6d.; Postage 2d. Pamphlets Free. W. C. HUGHES,
SPECIALIST, Brewster House, 88 Mortimer Road, Kingland, N.

THE AERIAL GRAPHOSCOPE (BRUCE'S PATENT).

Showing Lantern Pictures in Space and Relief without a
Screen, Weird Ghost Effects and Visions, and a variety of
Entirely Original Experiments on Persistence of Vision.

Exhibited at the Soirées of the Royal Society, Royal Insti-
tution, Society of Arts, London Institution, &c., &c.

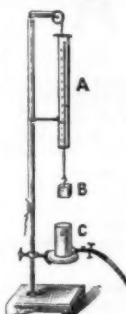
The Inventor, **Mr. ERIC STUART BRUCE**, M.A.
Oxon., F.R. Met. Society, can accept Engagements for his
Elaborately Illustrated Lecture on this complete Novelty, also
for shorter Demonstrations at Soirées, Photographic Exhi-
bitions, and other Entertainments.

APPLY TO

E. S. BRUCE, Esq.,

19 CAMPDEN HOUSE ROAD, KENSINGTON,
LONDON, W.

MOORE'S HYDROSTATIC BALANCE



FOR ILLUSTRATING THE "PRINCIPLE OF
ARCHIMEDES" AND SPECIFIC GRAVITY.

A is a delicate spring balance accurately graduated to
read Grams, and is capable of being lowered or raised
by the string shown.

B is one of the set of cubes of various metals supplied
with the apparatus.

C is a glass vessel with fixed mark etched in glass, up
to which water, or other liquid, is placed. The
vessel is provided with draw-off cock.

Sole Makers of this Apparatus—

BREWSTER, SMITH, & CO.,

6 CROSS STREET, FINSBURY, E.C.
Manufacturers and Importers of Chemical and Scientific
Apparatus and Pure Chemicals.

WEIGHTS a Speciality, 500 Milligrams to
1 Milligram, 1s. 6d. per doz.

SEND FOR COMPLETE ILLUSTRATED
CATALOGUE.

PHYSICAL AND MECHANICAL APPARATUS.

EVERETT & CO.,

Engineers and Electricians,

22 CHARTERHOUSE SQUARE, LONDON, E.C.

Scientific and Electrical Instrument Makers.

Apparatus for Laboratories, &c., designed and made to meet any
requirements.

MACHINES FOR ANY SPECIAL PURPOSE BUILT TO ORDER.

MODELS DESIGNED AND MADE FOR INVENTORS.

Accuracy combined with Highest Skill at Reasonable Charges.

REPAIRS OF EVERY DESCRIPTION.

PATENTS.

JAMES G. LORRAIN, M.I.E.E., M.I.MECH.E., &c.,

CHARTERED PATENT AGENT,

Norfolk House, Norfolk Street, LONDON, W.C.

Speciality—PHYSICAL PATENTS,

OPPOSITIONS, AND AMENDMENTS.

Charges on Application.

Telephone No. 2511 GERRARD.

Telegrams: "LORRAIN, LONDON."

"Patentees' Handbook" Post free on application.

PHŒNIX FIRE OFFICE,
19 LOMBARD ST., E.C., and 57 CHARING CROSS, S.W.
ESTABLISHED 1782.

MODERATE RATES. ABSOLUTE SECURITY.
ELECTRIC LIGHTING RULES SUPPLIED.
LIBERAL LOSS SETTLEMENTS.
PROMPT PAYMENT OF CLAIMS.
FRANCIS B. MACDONALD, SECRETARY.
LOSSES PAID OVER £22,000,000.

ESTABLISHED 1851.
BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

INVESTED FUNDS

£10,000,000.

The BIRKBECK ALMANACK, with full particulars, post free.
FRANCIS RAVENSCROFT, Manager.

THE MOST NUTRITIOUS.

E P P S'S

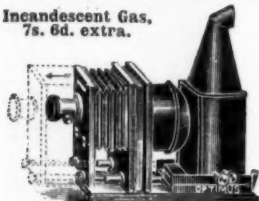
GRATEFUL—COMFORTING.

C O C O A

BREAKFAST—SUPPER.

"OPTIMUS" CANTILEVER PHOTOGRAPHIC ENLARGER.

Incandescent Gas,
7s. 6d. extra.



This already popular model is finished in a very superior and practical style. The lamp gives a brilliant and even light. The optical system is throughout the best. The Lens will be found to give a very flat field and good marginal definition.

* SUITED FOR POCKET
CAMERA NEGATIVES.

Diam. of Condenser ...	4in.	5in.	6in.	8in.	10in.
Price, no Front Lens ...	62/-	70/-	80/-	110/-	200/-
Extra for Front Lens ...	27/-	27/-	37/-	63/-	63/-
Covering Plates ...	3 1/2 x 3 1/2	4 1/2 x 3 1/2	6 1/2 x 4 1/2	8 1/2 x 5 1/2	

Catalogue POST FREE.

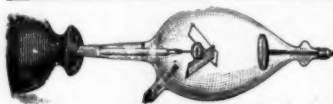
PERKEN, SON & RAYMENT,

SECOND-HAND MICROSCOPES

By SWIFT, WATSON, CROUCH, BECK, ZEISS, LEITZ, &c.
Prices from £2 10s. to £45.
A Large Selection of Second-hand Powers and Fittings for all kinds of Microscopes.

Send for New List.

CLARKSON & CO., 28 Bartlett's Buildings, Holborn Circus, E.C.



**GLASS
BLOWING**

GEISSLER TUBES IN BEAUTIFUL DESIGNS.

TUBES containing specimens of Fluorescent and Phosphorescent Minerals, Salts, Rubies, &c.

ILLUSTRATED TUBE contains Vanes which Fluoresce in three brilliant colours, and revolve by means of Cathode Rays.

COSSOR, 67 FARRINGDON ROAD, E.C.

**HOLLOWAY'S OINTMENT
CURES**

Gout, Rheumatism, Lumbago, Sciatica, Cuts,
Bruises, Sprains, &c.

INVALUABLE FOR ALL SKIN DISEASES.

Holloway's Ointment and Pills may be obtained of
all Medicine Vendors.

"OPTIMUS" MAGIC LANTERNS FOR DRAWING ROOM
AND LECTURE HALL.

Each Lantern is efficient for Exhibitions. The Lens gives crisp definition, being a superior Achromatic Photographic Combination, with Rack and Pinion, compound Condenser of 4in. diameter. Each has 3-wick Refulgent Lamp, and is Complete in box. (4-wick Lamp, 2s. extra.)



Mahogany outside Body, Panelled Door, Brass Stages, and 3-draw Sliding Tubes, so that lenses of long focus may be used when projecting upon a screen at a great distance, £5 5s.

Mahogany outside Body, lined with metal, making a thoroughly practical instrument, and really good value ... £2 12 0

Russian Iron Body, Brass Sliding Tubes (Educational)... 3 3 0

Do. do. (College) ... 2 8 0

99 HATTON GARDEN,
HOLBORN CIRCUS. E.C. **LONDON.**

HARVEY & PEAK

HAVE FOR DISPOSAL

**A VERY LARGE AND RARE
PROJECTION POLARISCOPE.**

Including Nicol Polariser of 3 1/2 inches aperture, Nicol Analyser of 3 1/4 inches aperture, many large Sections of Quartz, Quartz Devices, Crystals, Double Image Prisms, Selenites, &c., in Mahogany Cabinets.

56 CHARING CROSS ROAD, LONDON, W.C.

NOTICE.—Advertisements and business letters for NATURE should be addressed to the Publishers; Editorial communications to the Editor.
The telegraphic address of NATURE is "PHUSIS," LONDON.

SUBSCRIPTIONS TO "NATURE."

	£ s. d.	To ALL PLACES ABROAD:—	£ s. d.
Yearly	1 8 0	Yearly	1 10 6
Half-yearly	0 14 6	Half-yearly	0 15 6
Quarterly	0 7 6	Quarterly	0 8 0

Cheques and Money Orders payable to MACMILLAN & CO., Limited.

CHARGES FOR ADVERTISEMENTS.

	£ s. d.		£ s. d.
Three Lines in Column	0 2 6	Quarter Page, or Half a Column	1 15 0
Per Line after	0 0 9	Half a Page, or a Column	3 5 0
One Eighth Page, or Quarter Column	0 18 6	Whole Page	6 6 0

* The first line being in heavy type is charged for as Two Lines.
OFFICE: ST. MARTIN'S STREET, LONDON, W.C.

**THESE PRICES
WILL BE WITHDRAWN
AT THE END OF
THE PRESENT YEAR.**

**CHRISTMAS OR NEW YEAR
A HANDSOME PRESENT
FOR A COUNTRY HOUSE.**

The Proprietors of NATURE beg to announce that they will be unable to continue, after the close of the year, the offer they are now making of

**SOWERBY'S ENGLISH BOTANY
AT A GREATLY REDUCED PRICE.**

AUTUMN PRICES OF THE THIRTEEN VOLUMES:

CASH.
CLOTH BINDING, £16.

MONTHLY PAYMENTS.
£16 16s.

**THE PUBLISHER'S PRICE IS £25 FOR CLOTH.
HALF-MOROCCO SETS ALL SOLD.**

**NATURE RE-ISSUE OF
SOWERBY'S ENGLISH BOTANY.**

THIRD EDITION: WITH SUPPLEMENT.

CONTAINING A DESCRIPTION AND HAND-COLOURED

LIFE-SIZE DRAWING OF EVERY BRITISH PLANT.

FOR NATURALISTS AND COLLECTORS—A Recognised Standard Authority.

FOR GENERAL READERS—A Storehouse of Legends, Superstitions and Quotations.

FOR PICTURE-LOVERS—A Series of nearly Two Thousand Beautiful Plates.

With DESCRIPTIONS, POPULAR SKETCHES and INDICES.

Copies of the book may be seen at NATURE Office, St. Martin's Street, W.C. An explanatory pamphlet, giving specimen pages, full contents, extracts from the preface, with a specimen hand-coloured illustration and Order Form, will be sent Post free on application to

C. Worsfold, NATURE Office, St. Martin's Street, London, W.C.

ORDER FORM FOR MONTHLY PAYMENTS.

Date..... 1899.

All cheques should be crossed and made payable to C. Worsfold, NATURE Office, St. Martin's Street, W.C.

I enclose One Guinea as first payment for a copy of "Sowerby's English Botany" bound in Cloth, 16 Guineas, and I agree to pay to you, or to your representative, the balance at the rate of One Guinea per month; my next payment to be on the delivery of the volumes, and my remaining payments on the corresponding day of each month following.

Until such payments are complete, I engage that the work, not being my property, shall not be disposed of by sale or otherwise.

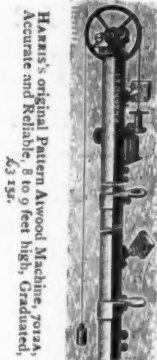
I further agree that if it be found impossible for any reason to deliver the book, the return of the sum of One Guinea to me shall cancel this agreement.

Name.....

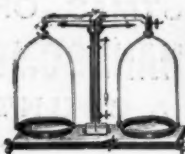
Address.....

Residents abroad are kindly requested to remit in full, or to instruct their representatives in England to make the monthly payments, in order to avoid expense and delay in forwarding cash from abroad.

CHRISTMAS ORDERS MAY BE MARKED "FOR DELIVERY BETWEEN DECEMBER 20 and 25."



Harris's original Patent Atwood Machine, 707A, Accurate and Reliable, 8 to 9 feet high. Graded, £3 12s.



Reliable Balances, 259A. 100 grm. to 1 mgm., Agate Planes and Knife Edges, £1 9s. 6d.; Steel, £1 4s.



Resistance Box, Post Office, £6 10s. 4775A.



New Mechanical Apparatus. See List.



Stroud and Rendell Lantern, £9s. 6d. 29A.

PHILIP HARRIS & Co., Ltd., Laboratory Furnishers, BIRMINGHAM.

Telegraphic Address :
"Science," Birmingham.
Telephone No. 10.

WATSON'S NEW MICROSCOPES AND APPARATUS.



WATSON'S HOLOSCOPIC EYEPIECES, for use with either APOCHROMATIC or ACHROMATIC OBJECTIVES, an adjustment being provided to the special lenses employed, for altering the correction. There is no sacrifice of efficiency, the performance being equal to the most expensive Compensating or Huyghenian Oculars.

Magnifying Powers—

6 in. tube length, 5, 7, 10, and 14 diameters.
10 in. " 7, 10, 14, and 20 "

PRICE, in Student's Size and Pattern, either power, 17/6 each.

For Full Particulars see Supplemental List, Post Free.

WATSON'S Parachromatic OIL IMMERSION CONDENSER.

Total aperture, 1.30; aplanatic aperture exceeds 1.25. Undoubtedly the finest Condenser obtainable for high-power work. Optical part only ... £5 0 0

Completely mounted with Iris Diaphragm and Set of Stops ... £8 10 0

WATSON'S "SCHOOL" MICROSCOPE, New Model, complete with 1 in. Objective, in Case ... £3 3 0

WATSON'S "ROYAL" MICROSCOPE. A new model high-class instrument.

WATSON'S "FRAM" MICROSCOPE. A highest-class instrument at a very moderate cost.

BACTERIOLOGICAL APPARATUS. MICROTOMES. Apparatus for FIELD BOTANY and FIELD GEOLOGY. METAMORPHOSES and DISSECTED PREPARATIONS. BOTANICAL and PHYSIOLOGICAL MODELS.

For Particulars of all the above, see Watson's New Supplemental List to Catalogue No. 2, Post Free on application.

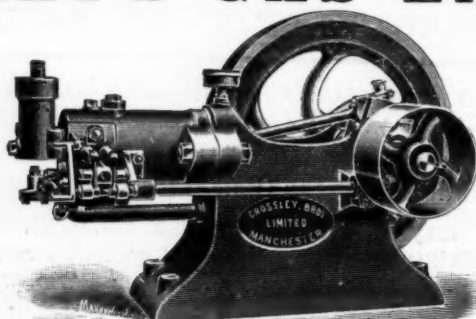
Watson's Catalogue (No. 3) is a Classified List representing a Stock of 40,000 first-class Micro-Slides, Post free on application.

W. WATSON & SONS (Established 1837), Opticians to H.M. Government.

313 HIGH HOLBORN, LONDON, W.C. New Branch Now Open: 16 FORREST ROAD, EDINBURGH. And at 78 Swanston Street, Melbourne, Australia. Awarded 39 Gold and other Medals at the principal International Exhibitions of the World.

CROSSLEY'S GAS ENGINES.

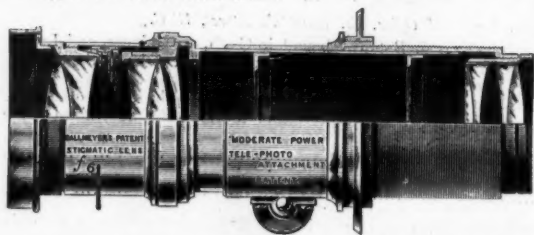
RECENTLY
REMDELLED.



GREAT
REDUCTION
IN
GAS
CONSUMED.

CROSSLEY BROS., LTD., OPENSHAW, MANCHESTER.

DALLMEYER'S TELE-PHOTO. LENSES & ATTACHMENTS



Enable you to take Photographs of Distant or Inaccessible Subjects of sufficient size to be of practical value.

Indispensable to Geologists, Naturalists, and Architects.

Price from £3 15s.

Prices and Particulars on application. Estimates and advice free.

Stigmatic Lens fitted with Tele-Photo. Attachment.
(These Attachments can be fitted to any good Lens.)

J. H. DALLMEYER, Ltd.,
25 Newman Street, London, W.



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

No. 1573, Vol. 61]

THURSDAY, DECEMBER 21, 1899.

[PRICE SIXPENCE.

Registered as a Newspaper at the General Post Office.]

[All Rights are Reserved.

NEWTON & CO.'S

NEW PATENT

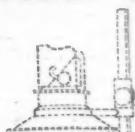
"DEMONSTRATOR'S" LANTERN,

FOR LIMELIGHT OR ELECTRIC.

With Prism for Erecting,
and for Vertical Projection.

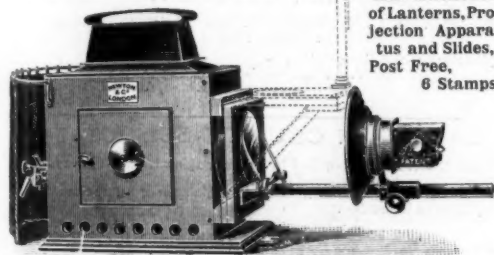
PRICE £10 10s.

3 FLEET ST.,
LONDON.



The most simple
and efficient
Single Lantern
yet constructed
for general
scientific work.

NEW CATALOGUE
of Lanterns, Pro-
jection Apparatus
and Slides,
Post Free,
6 Stamps.



CHESHIRE'S AND CROVA'S DISCS.

FOR ILLUSTRATING STATIONARY AND
PROGRESSIVE SOUND WAVES.

We are now making accurate Cardboard Models
of the above, for individual Student's use.

Price of the Set, consisting of two 10-inch Discs and Slit,
with full instructions, 1s.

JOHN J. GRIFFIN & SONS, L^d

20-26 SARDINIA STREET, LONDON, W.C.

LYELL'S STUDENTS' ELEMENTS OF GEOLOGY.

A NEW EDITION, THOROUGHLY REVISED AND
IN GREAT PART REWRITTEN BY

Professor J. W. JUDD, C.B., F.R.S.,

Of the Royal School of Mines.

With upwards of 600 Illustrations.

Crown 8vo. 9s.

"It was a happy thought to entrust the preparation of so
important a manual to one of the most intimate, and certainly
not the least eminent, of the surviving friends of Sir Chas.
Lyell. . . . It is hardly too much to say that Lyell's 'Principles
of Geology' is not unworthy to stand side by side with Darwin's
'Origin of Species' as an epoch-making book in modern
science."—*Standard*.

JOHN MURRAY, ALBEMARLE STREET, W.

CHRISTMAS PRESENTS. NEGRETTI & ZAMBRA'S Self-Registering Barometers, Thermometers and Rain Gauges.

Giving continuous Records on Charts, and only requiring attention
once a week.



THE LARGE SIZE BAROGRAPH. £7 10 0

Accurate Thermometers for all purposes.

"Special" Illustrated Price List of Instruments, suitable for
Presents, free by post to all parts of the World.

38 HOLBORN VIADUCT, E.C.

BRANCHES—45 CORNHILL, and 122 REGENT STREET.

CHRISTMAS LECTURES.

ROYAL INSTITUTION OF
GREAT BRITAIN.

ALBEMARLE STREET, PICCADILLY, W.

CHARLES VERNON BOYS, Esq., F.R.S., will, on Thursday next, December 28, at Three o'clock, begin a Course of Six Lectures (adapted to a Juvenile Auditory) on "Fluids in Motion and at Rest," Experimentally Illustrated. Subscription (for Non-Members) to this Course, One Guinea (Children under 16, Half-a-Guinea); to all the Courses in the Season, Two Guineas.

BACTERIOLOGY.

BACTERIOLOGICAL DEPARTMENT,
KING'S COLLEGE, LONDON.

Director: PROF. CROOKSHANK.

The Laboratories are open daily for Instruction and Research from 10 a.m. to 5 p.m. For Syllabus of Classes apply THE SECRETARY.

For Information and Advice as to the Course of Instruction to be selected, application must be made in writing to PROF. CROOKSHANK, or an interview may be obtained by appointment.

SPECIAL CLASSES IN JANUARY.

Two complete Courses of Practical Instruction for Medical Practitioners, Veterinary Surgeons, Analysts, &c., will commence on January 8th.

Demonstrations to the Morning Class (Dr. NEWMAN, D.P.H.) will be given at 11 a.m., and to the Afternoon Class (Dr. NASH, D.P.H.) will be given at 2 p.m.; three days a week, with practical work daily in the Laboratory for THIRTY DAYS.

A Class for Candidates for the D.P.H. (Bacteriology) will commence on January 8th at 10 a.m., and a Time Table arranged to suit the convenience of the Class.

A Class in Clinical Bacteriology, consisting of Demonstrations with practical work, will commence on Wednesday, January 10th (2 to 3.30), and be held on successive Wednesdays for six weeks.

THE LONDON SCHOOL OF TROPICAL
MEDICINE

(UNDER THE AUSPICES OF HER MAJESTY'S GOVERNMENT),
CONNAUGHT ROAD, ALBERT DOCK, E.

IN CONNECTION WITH THE HOSPITALS OF THE SEAMEN'S
HOSPITAL SOCIETY.

The next SESSION commences on MONDAY, JANUARY 15, 1900.

A Travelling Scholarship of £300 will be offered to Students of the School. The Laboratories, Museum, Library, &c., are open daily. Lectures on Tropical Medicine, Tropical Hygiene and Surgery in the Tropics, are delivered during the Session.

Clinical Instruction is given daily in the wards of the Hospitals. Special arrangements for Board will be made for those who may desire to reside on the premises.

For Prospectus, Syllabus, and other particulars, apply to the Secretary, P. MICHELLI, Esq., Seamen's Hospital, Greenwich, S.E.

UNIVERSITY COLLEGE, LONDON.

SPECTROSCOPY AND SPECTRUM PHOTOGRAPHY.

By E. C. C. BALY.

A Course of Eight Lectures dealing with the methods of Spectroscopy especially in connection with the Photography of the Spectrum will be given on Friday Evenings at 5.30 o'clock, commencing on January 19, 1900.

The following subjects will be treated and illustrated by experiments:—Refraction and Diffraction.—The Prism Spectroscope.—The Comparison of Spectra and Determination of Wave Lengths.—The Grating Spectroscope.—Concave Gratings; their Mounting and Adjustment.—Wave Length Determination with the Grating.—Photography of the Spectrum.—Methods of Producing Spectra.—Fluorescence and Phosphorescence. Fee for the Course, £1 1s.

J. M. HORSBURGH, M.A., Secretary.

UNIVERSITY COLLEGE, LONDON.

FACULTIES OF ARTS AND LAWS AND OF
SCIENCE.

The Second Term will begin on Tuesday, January 16. For Syllabus apply to

J. M. HORSBURGH, M.A., Secretary.

HEATHCOTE SCIENCE
LABORATORIES.

These Laboratories are open for RESEARCH work, at any hours or times most convenient for worker, in CHEMISTRY, PHYSICS and BACTERIOLOGY. Facilities for Commercial investigations are supplied. Furnaces and powerful Electrical Currents can be used.

The Fees are at rate of £3 3s. for one month (five days a week, six hours a day). Apparatus supplied free.

Private Laboratory, £4 14s. 6d. a month, or by arrangement.

The above Fees include use of all ordinary Glass and other Apparatus, and use of Accurate Balances and Standard General Instruments, also Furnaces, &c.

9 Heathcote Street, Mecklenburgh Square,
Gray's Inn Road, W.C.

R. C. T. EVANS,
Director.

B.A. and B.Sc.

MATRICULATION, INTERMEDIATE, FINAL.

PREPARATION by CORRESPONDENCE and ORAL TUITION on a THOROUGHLY INDIVIDUAL SYSTEM. Fees based on success.

The STAFF includes Graduates of Oxford, Cambridge, London, and Royal Universities, Science Medallists, Prizemen, Scholars, &c.

SINGLE SUBJECTS TAKEN: Latin, Greek, French, German, Mathematics, Science, Logic, Psychology, Political Economy, &c.

For Terms, &c., address Mr. J. CHARLESTON B.A. (London and Oxon.), The Burlington Classes, 27 Chancery Lane, London, W.C.

QUERNMORE. LONDON BRANCH at
24 CHANCERY LANE, W.C.

Tuition by JOHN GIBSON, M.A. (First Class, Camb.), and G. LÖLY, B.A. (First Class, London), for all Public Examinations. Special Instruction in Scientific Agriculture for successful practical Agriculture and Forestry in the British Islands or the Colonies; also in Chemistry, Physics, Geology, Botany, &c. Practical Chemical and Physical Laboratories. The "State Correspondent" and Higher Examination Journal gives up-to-date particulars of all the leading C.S. and other Examinations. Price 2d., post free. Prize of One Guinea for competition each month; Special Prize of Five Guineas each June and December.

Telegrams—"Tunzelmann, London."

THE ELECTRICAL

AND

GENERAL ENGINEERING COLLEGE.

PRESIDENT—G. W. DE TUNZELMANN, B.Sc. Lond., M.I.E.E.

PRINCIPAL—J. H. REEVES, M.A. Camb.

Present SESSION began WEDNESDAY, SEPTEMBER 27.

Particulars on application to the SECRETARY, 2 and 4 Penywern Road, Earl's Court, S.W.

SCIENCE EXAMINATIONS.

For LONDON and other UNIVERSITIES, the
CONJOINT BOARD, &c.

Well-equipped LABORATORIES, DAY AND EVENING. Personal

or Class Tuition free. Prize of One Guinea for competition each month; Special Prize of Five Guineas each June and December.

A SCIENCE GRADUATE,

HONOURS, CHEMISTRY,

REQUIRED IN CAMBRIDGE, TO TAKE SCIENCE
SUBJECTS.

Applications, with full particulars, to

"X. Y. Z.," c/o Hart's Advertising Offices,
Maltravers House, Arundel Street,
Strand, W.C.

CARDIGAN COUNTY SCHOOL.

SCIENCE MASTER Required by January 15 next. Must have taken a Degree. Commencing Salary, £120.

Applications, with qualifications and testimonials, on or before Saturday, January 6, to be in hands of

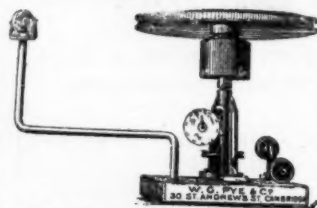
JAMES STEPHENS,
Clerk to the Managers, Cardigan.

ZOOLOGIST, 34, for 7½ years Assistant in

a leading Continental Museum, Author of Scientific Papers and Books, seeks Engagement as Curator, Assistant, Librarian, or the like.—"X. B.," NATURE Office.

W. G. PYE & CO.

Physical & Physiological Instrument Makers,
30 ST. ANDREW'S STREET, CAMBRIDGE.



Apparatus
for Determining
the
Mechanical Equivalent
of Heat.

PRICE
£4 10s.

Specialities for teaching Experimental Physics. Good quality, moderate prices. Resistance Boxes, Single Coils, KEYS, Galvanometers, Bridges, Batteries, etc.

Physical and Physiological Lists—Sixpence, Post free.

BARGAINS IN SCIENTIFIC BOOKS.

KIRBY AND HOFFMAN.—THE BEETLE-COLLECTOR'S HANDBOOK, by Dr. E. HOFFMAN and Dr. W. E. KIRBY, with 20 Coloured Plates, containing over 500 Coloured Figures, Crown 8vo, Cloth Gilt (pub. 4s. 6d.). 2s. 9d.

The only complete recent Guide for Beetle-Collecting. The CONTENTS deal with the Structure, Development, Habits, &c., of Beetles, How to Kill them, and How to Arrange the Collection, followed by Full Accounts of the Several Species, which the 500 coloured figures represent. "The plates contain upwards of 500 figures, and those of many of the larger species are excellent. We can recommend this work as one which is likely to induce many to collect."—*Science Gossip*.

STEWART (A., F.R.C.S.), OUR TEMPERAMENTS, THEIR STUDY AND THEIR TEACHING, a Popular Outline, large 8vo volume, with 30 Illustrations (some Coloured), including a Selection from Lodge's "Historical Portraits," showing the Chief Forms of Faces, Gilt Top (pub. 15s.). 3s.

"The book is exceedingly interesting, even for those who are not systematic students of anthropology. . . . To those who think the proper study of mankind is man, it will be full of attraction."—*Daily Telegraph*. "The author's object is to enable a student to read a man's temperament in his aspect. The work is well adapted to its end. It is worthy the attention of students of human nature."—*Scotsman*.

CAMPBELL (D. H.), THE STRUCTURE AND DEVELOPMENT OF THE MOSSES AND FERNS (ARCHEGONIATÆ), by DOUGLAS HOUGHTON CAMPBELL, Ph.D., fully Illustrated, Medium 8vo (pub. 14s. net). 4s.

"Dr. Campbell's book is clearly written, well illustrated, is provided with an accurate bibliography and a copious index, so that it will take its place at once as a standard classic, and will, we think, retain that position for no inconsiderable period."—*Gardener's Chronicle*.

Postage extra.

H. J. GLAISHER, New and Remainder Bookseller, 57 Wigmore Street, London, W.
Catalogues Post Free on application.

CO-OPERATIVE WORLD TRAVEL

Organised by HENRY S. LUNN, M.D., F.R.G.S.,
W. HOLDSWORTH LUNN, & CONNOP F. S. PEROWNE.

A Cruise to the WESTERN MEDITERRANEAN.

TILBURY, GIBRALTAR, TANGIER, ALGIERS, PALMA, VILLEFRANCHE (for NICE, CANNES, MONTE-CARLO), MARSEILLES.

A FIFTEEN DAYS' CRUISE FOR £9 9s. AND UPWARDS.

A Cruise to the EASTERN MEDITERRANEAN.

(Return ticket to MARSEILLES included.)

MARSEILLES, SYRACUSE, PIRÆUS (for Athens),
CONSTANTINOPLE, JAFFA (for Jerusalem), ALEXANDRIA,
MALTA, NAPLES, MARSEILLES.

A THIRTY-FIVE DAYS' CRUISE FOR £36 15s. AND UPWARDS
s.v. ARGONAUT. Tonnage, 3254; h.p., 4000.

Full particulars from the Secretary, 5 Endsleigh Gardens,
Euston, London, N.W.

TO SCIENCE LECTURERS.

HUGHES' MOTO-PHOTOSCOPE FOR LIVING PICTURES.
THE MOST PERFECT.

No SHUTTER, therefore no Flickering. Superb Mechanism.

The Moto-Photo Camera for taking the Pictures. Illustrated Lists, 2d. See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN, &c. Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great success. New Oxyhydrogen Microscope. Science Lanterns for Class Demonstration. Magnificent Results. Docwra Triple, Prize Medal, Highest Award. Supplied to the Royal Polytechnic Institution, Dr. H. GRATTAN GUINNESS, Madame ADELINA PATTI, &c., &c. Patent Pamphengos Science Lanterns. The Universal Lantern 4-inch Condenser, 4-wick Lamp, Portrait Combination front Lenses, 18s. 6d., Marvellous value. Science Lecture Sets. Novelties. The Lantern Kaleidoscope. Cheapest Lantern Outfits in the World. Grandly Illustrated Catalogue, over 180 choice Engravings, 6d.; Postage, 3d. List of 300 Lecture Sets, Science Subjects, Views, &c., 6d.; Postage 2d. Pamphlets Free. W. C. HUGHES, SPECIALIST, Brewster House, 82 Mortimer Road, Kingsland, N.

JUST PUBLISHED. 8vo. Price 15s. net.

THE KINETIC THEORY OF GASES.

ELEMENTARY TREATISE WITH MATHEMATICAL APPENDICES.

By DR. OSKAR EMIL MEYER,
Professor of Physics at the University of Breslau.

Translated from the Second Revised Edition by
ROBERT E. BAYNES, M.A.,
Student of Christ Church, Oxford, and Dr. Lee's Reader in Physics.
LONDON: LONGMANS, GREEN, & CO.

MR. SPENCER'S NEW VOLUME

NOW READY. 8vo, Cloth, price 18s.

THE PRINCIPLES OF BIOLOGY.

VOLUME II. Revised and Enlarged Edition.

By HERBERT SPENCER.

London: WILLIAMS & NORGATE, 14 Henrietta Street, W.C.

Cloth. Demy 8vo. Price 12s. Net.

AN INTRODUCTION TO THE STUDY OF THE

DIATOMACEÆ,

By FREDERICK WM. MILLS, F.R.M.S.

With a Bibliography by JULIAN DEBY, F.R.M.S.

CONTENTS.—Preliminary Remarks—The Structure of Diatoms—Movement of Diatoms—Classification of the Diatomaceæ, with a Conspectus of the Families and Genera—Modes of Reproduction—Collecting Diatoms—Mounting Diatoms—Microscopical Examination—How to Photograph Diatoms—Bibliography—Index.

London: ILIFFE, SONS, & STURMEY, Ltd., 3 St. Bride Street, E.C.

JAS. SWIFT & SON,

MANUFACTURING OPTICIANS.

SOLELY APPOINTED TO THE A.M. DEPT.,
WAR OFFICE, FOR THE SUPPLY
OF MICROSCOPES.



Patent form of Student's Microscope,
fitted with 2/3" and 1/6" Pan-Aplanatic
Objectives. Iris Diaphragm and Oculars,
in Case, from

£5 5s.

These Instruments we have supplied in
numbers to the following Medical Schools,
viz. St. Mary's, St. Bartholomew's, Guy's,
Middlesex, London, and St. Thomas's.

Seven Gold Medals awarded for excel-
lence of manufacture.

Catalogue on Application.

81 TOTTENHAM COURT ROAD, W.

C. BAKER'S MICRO-SLIDE LENDING DEPT.

SUBSCRIPTION: £1. 1. 0

For 12 Deliveries of 20 Slides each, Post free both ways.
CATALOGUES.

MICROSCOPES,
TELESCOPES, &c.

Post free on application.

244 HIGH HOLBORN, LONDON.

GLASS BLOWING.

All kinds of Experimental Glass
Blowing carried out for Scien-
tific Men, Laboratories, &c.

INVENTORS' IDEAS WORKED OUT AS PER
INSTRUCTIONS.

COSSOR,

67 FARRINGTON ROAD, E.C.



Shadow of
Cross Tube.

QUARTZ FIBRES. SCOTTISH PROVIDENT INSTITUTION.

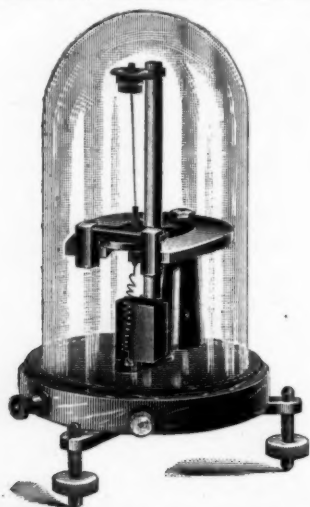
We are now making **QUARTZ FIBRES** about 40 cm. long, capable of supporting a weight of 50 grammes. These are especially suitable for suspending heavy magnets.

Price of Box containing 6 of these Fibres,
£1 0 0

FIBRES SUITABLE FOR GALVANOMETER SUSPENSIONS.

In Box containing 6 Fibres 16 cm. long	-	5	0
" " " 30 "	-	7	6
" " " 40 "	-	10	0

SCIENTIFIC INSTRUMENT CO.
LIMITED,
CAMBRIDGE.



GAMBRELL BROS.,
17 GILTSPUR STREET, LONDON.

Student's Moving Coil Reflecting Galvanometer with adjustable brass tube for damping the movement, **£3 15s.**

Bridge for use with the above 1 to 11,110 ohms, and Three Pairs of Proportional Coils, **£6 0 0.**

PRICE LIST ON APPLICATION.

HEAD OFFICE: 6 St. Andrew Square, EDINBURGH.

MUTUAL ASSURANCE with MODERATE PREMIUMS.

More than one half of the Members who died during the Septennial period were entitled to Bonuses which, notwithstanding that the premiums do not as a rule exceed the non-profit rates of other Offices, were on the average equal to an Addition of about 50 per cent. to the Policies which participated.

The SURPLUS at last Division was **£1,423,000.**

Examples of Premium for £100 at Death, with Profits.

AGE.	30*	35	40	45	50	55
DURING LIFE,	£3 1 6	£2 6 10	£2 14 9	£3 5 9	£4 1 7	£5 1 11
25 PAYMENTS,	2 13 0	2 17 9	3 4 6	3 14 0	4 8 7	5 6 11
15 PAYMENTS,	3 12 1	3 18 0	4 5 8	4 16 2	5 11 8	6 9 11

* A person of 30 may secure £1000 at death by a yearly payment, during life, of £20 15s., which would in many Offices secure (with profits) £800 only. Or he may secure £1000 by 25 payments of £26 10s., being thus free of payment before age 55.

ACCUMULATED FUNDS, £11,000,000.

Prospectus, with full information, on application.

LONDON OFFICE: 17 KING WILLIAM STREET, E.C.
J. MUIR LEITCH, Secretary.

IMPROVED D'ARSONVAL GALVANOMETERS.

PRICES
£10-0-0

AND

£4-10-0

LIBERAL DISCOUNTS.

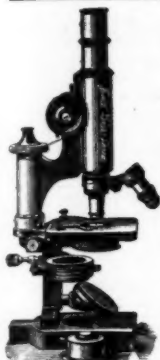


Most SENSITIVE for DEFLECTIVE, ZERO, or BALLISTIC WORK.

Write for Price List and Particulars of Potentiometers, Galvanometers, Electrical Thermometers, Experimental Direct and Alternating Current Sets, &c., to

CROMPTON & CO., LD.,

Laboratory { "THRIPLANDS," } LONDON, W.
KENSINGTON COURT,

**CARL ZEISS,**

(OPTICAL WORKS, JENA.)

LONDON BRANCH:

29 MARGARET STREET, REGENT STREET, W.

MICROSCOPES and ACCESSORIES

—For Bacteriology, Biology, Mineralogy and Student's use. —Apochromatic, Achromatic Objectives. —Micrometers, &c.

OPTICAL MEASURING INSTRUMENTS.

—Spherometers, New Crystal Refractometer, Butter-Refractometer for the rapid determination of the purity of Butter, Lard, and Glycerine.

NOTE.—We do not make Theodolites.

Illustrated Catalogues, including new edition (1898) of Catalogue of Microscopes, free. Please state which required

PHOENIX FIRE OFFICE,
19 LOMBARD ST., E.C., and 57 CHARING CROSS, S.W.
ESTABLISHED 1782.MODERATE RATES. ABSOLUTE SECURITY.
ELECTRIC LIGHTING RULES SUPPLIED.LIBERAL LOSS SETTLEMENTS.
PROMPT PAYMENT OF CLAIMS.

FRANCIS B. MACDONALD, SECRETARY.

LOSSES PAID OVER £22,000,000.

For Photography, Unsurpassed for fine definition.

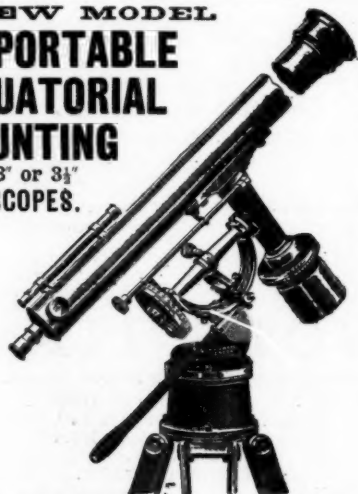
COOKE LENSESTAYLOR, TAYLOR, & HOBSON,
Stoughton Street Works, Leicester;
and 18 Berners Street, London, W.**"No Better Food."**

Dr. ANDREW WILSON, F.R.S.E., &c.

Fry's PURE
CONCENTRATED **Cocoa**

250 Gold Medals and Diplomas.

N.B.—Just three words are necessary in order to obtain the right Cocoa,

viz. **FRY'S—PURE—CONCENTRATED.****NEW MODEL
PORTABLE
EQUATORIAL
MOUNTING**
For 3" or 3½"
TELESCOPES.

Latitude Adjustment, Clamp for Declination Axis, Quick and Slow Motion, in Right Ascension.

EQUATORIAL MOUNTING with Divided Circles and Stand fitted with short Iron Column, Levelling Screws, and Metal Stretcher, £15 15s.; or, complete with 3" Telescope, £25.

ILLUSTRATED CATALOGUE GRATIS.

J. H. STEWARD,
OPTICIAN,406 STRAND, 457 WEST STRAND,
7 GRACECHURCH STREET, LONDON.**C. E. MÜLLER & CO.,**
SCIENTIFIC GLASS BLOWERS,

AND MANUFACTURERS OF

CHEMICAL & PHYSICAL APPARATUS,
X-Ray Tubes, Argon and Helium Spectrum Tubes,
Special Apparatus for Research, Chemical
Thermometers, &c., &c.**NEW
GEISSLER
TUBES.**

The Flowers appearing in their Natural Colours under the Kathode Rays.

PRICE £1 1 0

AN ASSORTMENT KEPT IN STOCK.

PRICE LISTS OF CHEMICAL
APPARATUS ON APPLICATION.148 HIGH HOLBORN,
LONDON, W.C.

BORD'S PIANOS

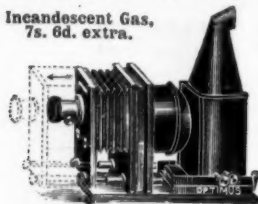
BECHSTEIN PIANOS

25 per cent. Discount for Cash, or 14/6 per month (second-hand, 10/6 per month) on the Three Years' System. Lists free of
C. STILES & CO., 40 & 42 Southampton Row, London, W.C.
PIANOS EXCHANGED.

These magnificent Pianos for Hire on the Three Years' System at advantageous prices and terms. Lists and particulars free of
CHAS. STILES & CO., 40 & 42 Southampton Row, LONDON, W.C.

"OPTIMUS" CANTILEVER PHOTOGRAPHIC ENLARGER.

Incandescent Gas,
7s. 6d. extra.



This already popular model is finished in a very superior and practical style. The lamp gives a brilliant and even light. The optical system is throughout the best. *The Lens will be found to give a very flat field and good marginal definition.*

* SUITED FOR POCKET
CAMERA NEGATIVES.

Diam. of Condenser ...	* 4in.	5in.	6in.	8in.	10in.
Price, no Front Lens ...	62/-	70/-	80/-	110/-	200/-
Extra for Front Lens ...	27/-	27/-	37/-	63/-	63/-
Covering Plates ...	3 1/4 x 3 1/4	4 1/4 x 3 1/4	6 1/4 x 4 1/4	8 1/4 x 5 1/4	

Catalogue POST FREE.

"OPTIMUS" MAGIC LANTERNS FOR DRAWING ROOM AND LECTURE HALL.

Each Lantern is efficient for Exhibitions. The Lens gives crisp definition, being a superior Achromatic Photographic Combination, with Rack and Pinion, compound Condenser of 4in. diameter. Each has 3-wick Refulgent Lamp, and is Complete in box. (4-wick Lamp, 2s. extra.)



Mahogany outside Body, Panelled Door, Brass Stages, and 3-draw Sliding Tubes, so that lenses of long focus may be used when projecting upon a screen at a great distance, £5 5s.

Mahogany outside Body, lined with metal, making a thoroughly practical instrument, and really good value ... £2 12 0

Russian Iron Body, Brass Sliding Tubes (Educational)... 3 3 0

Do. do. (College) ... 2 8 0

PERKEN, SON & RAYMENT, 99 HATTON GARDEN, HOLBORN CIRCUS, E.C. LONDON.

THE AERIAL GRAPHOSCOPE

(BRUCE'S PATENT).

Showing Lantern Pictures in Space and Relief without a Screen, Weird Ghost Effects and Visions, and a variety of Entirely Original Experiments on Persistence of Vision.

Exhibited at the Soirées of the Royal Society, Royal Institution, Society of Arts, London Institution, &c., &c.

The Inventor, **Mr. ERIC STUART BRUCE, M.A.** Oxon., F.R. Met. Society, can accept Engagements for his Elaborately Illustrated Lecture on this complete Novelty, also for shorter Demonstrations at Soirées, Photographic Exhibitions, and other Entertainments.

APPLY TO

E. S. BRUCE, Esq.,

19 CAMPDEN HOUSE ROAD, KENSINGTON, LONDON, W.

EVERETT & CO., MECHANICAL ENGINEERS AND ELECTRICIANS,

22 CHARTERHOUSE SQUARE, E.C.

Makers of High-Grade Physical and Electrical Apparatus. Apparatus designed and made for Laboratories and Research Work. ALL KINDS OF EXPERIMENTAL WORK.

HIGH-CLASS WORKMANSHIP AND ACCURACY A SPECIALITY.

MODELS DESIGNED, &C.

REPAIRS OF EVERY DESCRIPTION.

PATENTS.

JAMES G. LORRAIN, M.I.E.E., M.I.MECH.E., &c.,
CHARTERED PATENT AGENT,
Norfolk House, Norfolk Street, LONDON, W.C.

Speciality—PHYSICAL PATENTS, OPPOSITIONS, AND AMENDMENTS.

Charges on Application.

Telephone No. 2511 GERRARD. Telegrams: "LORRAIN, LONDON."
"Patentees' Handbook" Post free on application.

SCIENTIFIC WORTHIES.

The following is a list of the Steel Portraits that have appeared in the above Series:—

MICHAEL FARADAY.
THOMAS HENRY HUXLEY.
CHARLES DARWIN.
JOHN TYNDALL.
SIR GEORGE GABRIEL STOKES.
SIR CHARLES LYELL.
SIR CHARLES WHEATSTONE.
SIR WYVILLE THOMSON.
ROBERT WILHELM BUNSEN.
LORD KELVIN.
BARON ADOLF ERIK NORDENSKJÖLD.

HERMANN L. F. HELMHOLTZ.
SIR JOSEPH DALTON HOOKER.
WILLIAM HARVEY.
SIR GEORGE B. AIRY.
J. LOUIS R. AGASSIZ.
JEAN BAPTISTE ANDRÉ DUMAS.
SIR RICHARD OWEN.
JAMES CLERK MAXWELL.
JAMES PRESCOTT JOULE.
WILLIAM SPOTTISWOODE.
ARTHUR CAYLEY.
SIR C. W. SIEMENS.

JOHN COUCH ADAMS.
JAMES JOSEPH SYLVESTER.
DMITRI IVANOWITSH MENDELEEF.
LOUIS PASTEUR.

SIR ARCHIBALD GEIKIE.
LORD LISTER.
STANISLAO CANNIZZARO.
PROF. VON KÖLLIKER.
PROF. SIMON NEWCOMB.

N.B.—The Portraits of Sir A. Geikie, Lord Lister, Prof. Cannizzaro, Prof. von Kölliker, and Prof. S. Newcomb belong to a New Series and are Photogravures.

Proof impressions of these, printed on India paper, may be had from the Publishers, price 5s. each; or the Series of 32 Portraits in a Handsome Portfolio for £8 5s., carriage paid. The Portfolio may be had separately, price 6s.

Cheques and Money Orders payable to **MACMILLAN & CO., Limited.**

OFFICE OF "NATURE," ST. MARTIN'S STREET, LONDON, W.C.

PHYSIOGRAPHY and GEOLOGY. COLLECTIONS & MICROSCOPIC SLIDES,

As advised by Science and Art Directory, arranged by
JAMES R. GREGORY & CO.,
Mineralogists, &c.,
To Science and Art Department, British, Indian and Colonial
Museums, &c.
**NOVELTIES and RARE GEMS and PRECIOUS
STONES.**
*Mineral Specimens for Museums, and Collectors, and all purposes.
Rock Specimens and Microscopic Sections of Rocks and Minerals
cut to order.*
NEW AND VALUABLE MINERAL SPECIMENS CONSTANTLY
ARRIVING.
Stores & Offices: **1 Kelso Place, KENSINGTON, W.**
NEW CATALOGUES AND LISTS FREE.

ESTABLISHED 1851.

BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

INVESTED FUNDS

£10,000,000.

The BIRKBECK ALMANACK, with full particulars, post free.

FRANCIS RAVENSCROFT, Manager.

THE MOST NUTRITIOUS.

E P P S'S

GRATEFUL—COMFORTING.

C O C O A

BREAKFAST—SUPPER.

LIVING SPECIMENS FOR THE MICROSCOPE.

Volvox, Spirogyra, Desmids, Diatoms, Amœba, Arcella, Actinosphaerium,
Vorticella, Stentor, Hydra, Floscularia, Stephanoceros, Melicerta, and many
other Specimens of Pond Life. Price 1s. per Tube, Post Free. Helix
pomatia, Astacus, Amphioxus, Rana, Anodon, &c., for Dissection purposes.

THOMAS BOLTON,

25 BALSALL HEATH ROAD, BIRMINGHAM.

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM.

THE LABORATORY, PLYMOUTH.

The following animals can always be supplied, either living
or preserved by the best methods:—

Sycon; Clava, Obelia, Sertularia; Actinia, Tealia, Caryophyllia, Alcy-
onium; Hormiphora (preserved); Leptopiana; Lineus, Amphiporus; Nereis,
Aphrodite, Arenicola, Lanice, Terebella; Lepas, Balanus, Gammarus,
Ligia Mysis, Nebalia, Carcinus; Patella, Buccinum, Eledone, Pectens
Bugaia, Crisia, Pedicellina, Holothuria, Asterias, Echinus; Ascidia, Salpa
(preserved), Scyllium, Rana, &c., &c.

For prices and more detailed lists apply to
Biological Laboratory, Plymouth.

THE DIRECTOR.

NOTICE.—Advertisements and business letters for NATURE should be addressed to the Publishers; Editorial
communications to the Editor. The telegraphic address of NATURE is "PHUSIS," LONDON.

SUBSCRIPTIONS TO "NATURE."

	£	s.	d.
Yearly	1	8	0
Half-yearly	0	14	6
Quarterly	0	7	6
TO ALL PLACES ABROAD:—			
Yearly	1	10	6
Half-yearly	0	15	6
Quarterly	0	8	0

Cheques and Money Orders payable to MACMILLAN & CO., Limited.

OFFICE: ST. MARTIN'S STREET, LONDON W.C.

WATKINS & DONCASTER,

NATURALISTS,
AND MANUFACTURERS OF

CABINETS AND APPARATUS

FOR ENTOMOLOGY, BIRDS' EGGS, AND ALL BRANCHES OF
NATURAL HISTORY.

SPECIAL SHOW-ROOM FOR CABINETS.

Call or send for detailed Catalogue (88 pp.), Post free on
application.

N.B.—For Excellence and Superiority of Cabinets and
Apparatus, references are permitted to distinguished
patrons, Museums, Colleges, &c.

A LARGE STOCK OF INSECTS AND BIRDS' EGGS

Birds, Mammals, &c., Preserved and Mounted by First-class Workmen
with true natural surroundings. All Books and Publications on Natural
History supplied.

36 STRAND, LONDON, W.C.
(Five Doors from Charing Cross.)

CABINETS

ENTOMOLOGICAL AND ALL BRANCHES OF NATURAL HISTORY.

J. T. CROCKETT & SON are ACTUAL MAKERS.

Great advantages in dealing direct with them.

ALL BEST WORK. ESTIMATES GIVEN.

SEND FOR FULL DETAILED PRICE LIST BEFORE ORDERING ELSEWHERE.

7a PRINCES STREET, CAVENDISH SQUARE, LONDON, W.

Factories: 34 Riding House Street and Ogle Street, W.

MINERALS, ROCKS & FOSSILS.

COLLECTIONS FOR STUDENTS.

Carefully labelled and arranged in Boxes with Card Trays.

50 Minerals, 12/6; 100 do., 21/-; 200 do., 42/-.

Rocks and Fossils at similar prices.

300 Minerals in Cabinet, £4 4s.; 400 do., £5 12s. 6d.

Catalogues Post Free.

THOMAS D. RUSSELL,

78 NEWGATE STREET, LONDON, E.C.

ALBERT EDWARD JAMRACH

(Late CHARLES JAMRACH),

NATURALIST.

180 ST. GEORGE STREET EAST.

Implements of Savage Warfare, Idols, Sacred Masks, Peruvian Pottery,
Netsukis China, Lacquers, Gongs, Shells, and other Curios.

HOLLOWAY'S PILLS

CURE

Biliousness, Sick Headache, Indigestion, and
all Internal Complaints.

CAN BE TAKEN BY THE MOST DELICATE.

Holloway's Pills and Ointment may be obtained of
all Medicine Vendors.

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
*Three Lines in Column	0	2	6
Per Line after	0	0	9
One Eighth Page, or Quarter Column	0	18	6
Quarter Page, or Half a Column	1	15	0
Half a Page, or a Column	3	5	0
Whole Page	6	6	0

* The first line being in heavy type is charged for as Two Lines.

The... 'N. & G.' Cameras

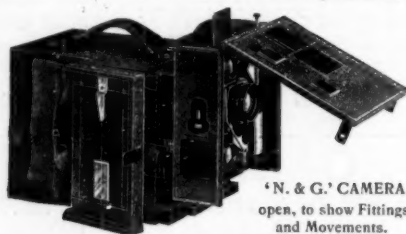
In all sizes up to 7 x 5 in.
For Plates, Cut Films, or Film
in Spools.

For Hand and Tripod.

A Series of High-Class Instruments for Serious Work,
embodying every New Advance in Photography.

Prices from £13 to £50.

Have been in Constant Use for Eight Years in all parts of the World.



'N. & G.' CAMERA,
open, to show Fittings
and Movements.

TRIPOD CAMERAS, SURVEYING CAMERAS, and very Small and
Light POCKET CAMERAS for Travellers and Field Naturalists.

Speciality: COMPLETE OUTFITS for Scientific Expeditions and Special Research.

Catalogues and Estimates. Lenses, Kinematographs, Lanterns, and all
free on application. Photographic Accessories and Materials.

Newman & Guardia, Ltd.

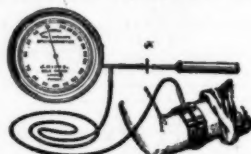
90 & 92 Shaftesbury Avenue, London, W.

JAS. J. HICKS, 8, 9 & 10, HATTON GARDEN, LONDON, SCIENTIFIC INSTRUMENT MAKER

TO THE

WAR OFFICE, INDIA OFFICE, ADMIRALTY, &c.,

IS SOLE MAKER OF THE



NEW PATENT SPHYGMOMETER,

By Drs. HILL and BARNARD. It is of special construction and a simple and accurate arterial pressure gauge. It is marvellously sensitive, and consists of a metal tambour, the expansion of which is exhibited in a highly magnified form by means of an index or pointer which travels round a dial. The dial is graduated in millimetres of mercury. The armlet, pump, and pressure gauge fit conveniently into a leather case when not in use. By means of this instrument the arterial pressure can be taken in man as rapidly, simply, and accurately as the temperature can be taken with the clinical thermometer.

**Price of Sphygmometer, £5.
Spare Bag and Tube, 5s.**

Descriptive Pamphlet of Sphygmometer, with Hundreds of Experiments by various Doctors, now ready, sent Free on Application.

OPPOSITE THE BRITISH MUSEUM.

THACKERAY HOTEL

(TEMPERANCE),

GREAT RUSSELL STREET, LONDON.

THIS newly-erected and commodious Hotel will, it is believed, meet the requirements of those who desire all the conveniences and advantages of the larger modern licensed hotels at moderate charges. Passenger Lift. Electric Light in all Rooms. Bath-rooms on every Floor. Spacious Dining, Drawing, Writing, Reading, and Smoking Rooms. All Floors Fireproof. Perfect Sanitation. Night Porter. Telephone. Bedrooms from 2s. 6d. to 4s. 6d. per night. Full Tariff and Testimonials on application.

Telegraphic Address: "THACKERAY, LONDON."

Proprietor—J. TRUSLOVE.

Also, amalgamated with, and under the same management,

ESMOND HOTEL

(TEMPERANCE),

MONTAGUE STREET, RUSSELL SQUARE.

THIS Hotel, which has been carried on so successfully for the last 13 years, adjoins the British Museum, and is exceptionally quiet. Bedrooms from 2s. to 3s. 6d. per night. Full Tariff and Testimonials on application.

Telegraphic Address: "TRUSLOVE, LONDON."

Proprietor—J. TRUSLOVE.

TO SCIENTIFIC MEN, NATURALISTS, TRAVELLERS, AND OTHERS.

THE
LONDON
STEREOSCOPIC
Company

Pay
special
ATTENTION

To the details of Photographic Outfits for Scientific Men, Naturalists, Travellers, and others who require the Apparatus to be exact in every particular, and to be made on Scientific lines. THE STEREOSCOPIC COMPANY also make a speciality of Twin Lens Cameras, and can show the largest Stock in London of practical and highly-finished Hand Cameras of every kind.



Extract of Letter from R. BOWDLER SHARPE, Esq., LL.D., Assist. Keeper Zoological Dept., British Museum, March 4, 1898:—"I consider it one of the best day's work I ever did when I bought one of your Cameras. The ease with which it is worked, and the excellent results obtained, make it a most pleasurable accompaniment of a summer's outing."

FREE LESSONS OR DEMONSTRATIONS TO PURCHASERS.

THE STEREOSCOPIC COMPANY,
108 and 108 REGENT STREET, W., and 54, Cheapside, E.C.

CATALOGUE FREE.

Printed by RICHARD CLAY AND SONS, LIMITED, at 7 & 8 Bread Street Hill, Queen Victoria Street, in the City of London and published by MACMILLAN AND CO., LIMITED, at St. Martin's Street, London, W.C., and THE MACMILLAN COMPANY, 66 Fifth Avenue, New York.—THURSDAY, DEC. 21, 1902.

GENERAL LIBRARY,
UNIV. OF MICH.
JAN 8 1900



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

No. 1574, VOL. 61]

THURSDAY, DECEMBER 28, 1899.

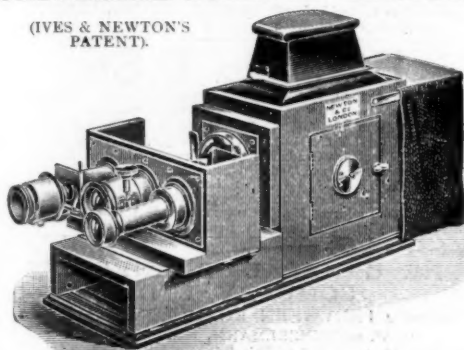
[PRICE SIXPENCE.

Registered as a Newspaper at the General Post Office.]

[All Rights are Reserved.

THE "NEWTONIAN" UNIVERSAL SCIENCE LANTERN

(IVES & NEWTON'S
PATENT).



Complete for Slides, Microscopic Objects, and Spectra.
Price £18.
For Lecturers on Light, Colour, and Colour Photography, &c.
Sole Makers: **NEWTON & CO., 3 FLEET STREET, LONDON.**

BECK'S NEW MICROSCOPE THE "BRITISH STUDENTS."

Microscope Stand No. 55, as
figured, with Iris Diaphragm,
One Eye-piece; Double Nose-
piece, Two Object-glasses, $2/3$ "
and $1/8$ ", adjusted to be in
about focus, and the whole
packed in polished Mahogany
Case,

£6 : 8 : 6

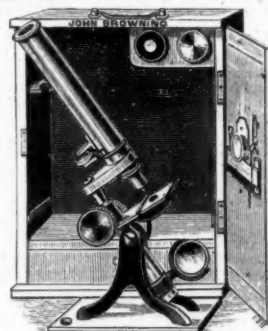


No. 55.

R. & J. BECK, Ltd.,
68 CORNHILL, LONDON, E.C.

BROWNING'S

"PERFECT"



MICROSCOPE.

The body is made entirely of brass and gun-metal, with rack-motion and fine
screw adjustment. Three achromatic powers (separable) of excellent defining
power, 1-inch, $1/2$ -inch, and $1/4$ -inch; adjusting slide-holder to stage, revolving
diaphragm, hand-forceps, stage-forceps, live-cage, &c. The whole packed
in upright Mahogany Cabinet, with drawer for slides, dissecting-knives, &c.

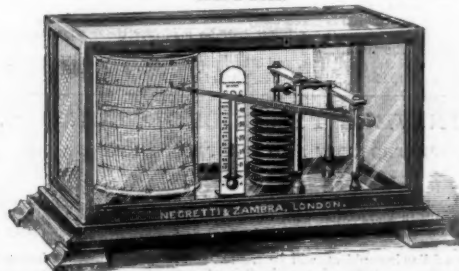
PRICE £3 15s. 0d.

New Illustrated Catalogue of Microscopes free.

JOHN BROWNING, 63 STRAND, LONDON, W.C.

NEW YEAR'S GIFTS. NEGRETTI & ZAMBRA'S Self-Registering Barometers, Thermometers and Rain Gauges.

Giving continuous Records on Charts, and only requiring attention
once a week.



THE LARGE SIZE BAROGRAPH, £7 10 0

Accurate Thermometers for all purposes.

"Special" Illustrated Price List of Instruments, suitable for
Presents, free by post to all parts of the World.

38 HOLBORN VIADUCT, E.C.

BRANCHES—45 CORNHILL, and 122 REGENT STREET.

UNIVERSITY OF WALES.

MATRICULATION EXAMINATION, 1900.

The University Court will shortly appoint MATRICULATION EXAMINERS as follows:—

Subjects.	Present Examiners.
English Language and the History of England and Wales	*Professor J. W. Hales, M.A. Professor J. K. Laughton, M.A.
Mathematics	*R. B. Hayward, M.A., F.R.S. Major P. A. McMahon, R.A., F.R.S.
Latin	E. S. Shuckburgh, M.A. *Professor E. A. Sonnenschein, M.A.
Greek	*R. D. Hicks, M.A.
Welsh	Professor John Rhys, M.A., LL.D.
French	H. E. Berthou, B. ès. L.
German	*Professor Kuno Meyer, Ph.D., M.A.
Dynamics	*Professor G. M. Minchin, M.A., F.R.S.
Chemistry	*H. F. Morley, D.Sc., M.A.
Botany	*Professor J. Reynolds Green, D.Sc., F.R.S.

The Examiners whose names are marked with a * have served for the full period of three years.

Particulars will be given by the REGISTRAR of the University, Brecon, to whom applications must be sent on or before January 30th, 1900.

IVOR JAMES,
Registrar of the University of Wales, Brecon.

December, 1899.

BACTERIOLOGY.

BACTERIOLOGICAL DEPARTMENT,
KING'S COLLEGE, LONDON.

Director: PROF. CROOKSHANK.

The Laboratories are open daily for **Instruction and Research** from 10 a.m. to 5 p.m. For Syllabus of Classes apply THE SECRETARY.

For Information and Advice as to the Course of Instruction to be selected, application must be made in writing to PROF. CROOKSHANK, or an interview may be obtained by appointment.

SPECIAL CLASSES IN JANUARY.

Two complete Courses of Practical Instruction for Medical Practitioners, Veterinary Surgeons, Analysts, &c., will commence on January 8th.

Demonstrations to the Morning Class (Dr. NEWMAN, D.P.H.) will be given at 11 a.m., and to the Afternoon Class (Dr. NASH, D.P.H.) will be given at 2 p.m.; three days a week, with practical work daily in the Laboratory for THIRTY DAYS.

A Class for Candidates for the D.P.H. (Bacteriology) will commence on January 8th at 10 a.m., and a Time Table arranged to suit the convenience of the Class.

A Class in Clinical Bacteriology, consisting of Demonstrations with practical work, will commence on Wednesday, January 10th (2 to 3.30), and be held on successive Wednesdays for six weeks.

THE LONDON SCHOOL OF TROPICAL
MEDICINE

(UNDER THE AUSPICES OF HER MAJESTY'S GOVERNMENT),
CONNAUGHT ROAD, ALBERT DOCK, E.

IN CONNECTION WITH THE HOSPITALS OF THE SEAMEN'S
HOSPITAL SOCIETY.

The next SESSION commences on MONDAY, JANUARY 15, 1900. A Travelling Scholarship of £300 will be offered to Students of the School. The Laboratories, Museum, Library, &c., are open daily. Lectures on Tropical Medicine, Tropical Hygiene and Surgery in the Tropics, are delivered during the Session.

Clinical Instruction is given daily in the wards of the Hospitals. Special arrangements for Board will be made for those who may desire to reside on the premises.

For Prospectus, Syllabus, and other particulars, apply to the Secretary, P. MICHELLI, Esq., Seamen's Hospital, Greenwich, S.E.

UNIVERSITY COLLEGE, LONDON.

SPECTROSCOPY AND SPECTRUM PHOTOGRAPHY.

By E. C. C. BALY.

A Course of Eight Lectures dealing with the methods of Spectroscopy especially in connection with the Photography of the Spectrum will be given on Friday Evenings at 5.30 o'clock, commencing on January 19, 1900.

The following subjects will be treated and illustrated by experiments:—Refraction and Diffraction.—The Prism Spectroscope.—The Comparison of Spectra and Determination of Wave Lengths.—The Grating Spectroscope.—Concave Gratings; their Mounting and Adjustment.—Wave Length Determination with the Grating.—Photography of the Spectrum.—Methods of Producing Spectra.—Fluorescence and Phosphorescence. Fee for the Course, £1 1s.

J. M. HORSBURGH, M.A., Secretary.

BIRKBECK INSTITUTION,

Breams Buildings, Chancery Lane, E.C.

Science Classes with Practical Work.

DAY AND EVENING CLASSES for University of London B.Sc.; Prelim. Scientific, Inter. M.B. Examinations and for Conjoint Board, Dental and Pharmaceutical Examinations.

EVENING CLASSES in all stages for Science and Art Department Examinations.

HIGHLY-EQUIPPED LABORATORIES.

Chemistry, Physics, Biology (Zoology and Botany), Metallurgy, Geology and Mineralogy, Microscopy.

Prospectus free. Calendar 6d. (Post 8d.) on application to Secretary.

HEATHCOTE SCIENCE
LABORATORIES.

These Laboratories are open for RESEARCH work, at any hours or times most convenient for worker, in **CHEMISTRY, PHYSICS and BACTERIOLOGY**. Facilities for Commercial investigations are supplied. Furnaces and powerful Electrical Currents can be used.

The Fees are at rate of £3 3s. for one month (five days a week, six hours a day). Apparatus supplied free.

Private Laboratory, £4 14s. 6d. a month, or by arrangement.

The above Fees include use of all ordinary Glass and other Apparatus, and use of Accurate Balances and Standard General Instruments, also Furnaces, &c.

9 Heathcote Street, Mecklenburgh Square,
Gray's Inn Road, W.C.

R. C. T. EVANS,
Director.

B.A. AND B.Sc.

MATRICULATION, INTERMEDIATE, FINAL.

PREPARATION by CORRESPONDENCE and ORAL TUITION on a THOROUGHLY INDIVIDUAL SYSTEM. Fees based on success. The STAFF includes Graduates of Oxford, Cambridge, London, and Royal Universities, Science Medallists, Prizemen, Scholars, &c.

SINGLE SUBJECTS TAKEN: Latin, Greek, French, German, Mathematics, Science, Logic, Psychology, Political Economy, &c.

For Terms, &c., address Mr. J. CHARLESTON B.A. (Lond. and Oxon.), The Burlington Classes, 27 Chancery Lane, London, W.C.

Telegrams—"Tunzelmann, London."

THE GENERAL ENGINEERING
COMPANY, LTD.,

2 and 4 PENYVERN ROAD, LONDON, S.W.

G. W. DE TUNZELMANN, Managing Director.

Mechanical, Electrical and Chemical Patents experimentally developed and Models constructed for Inventors. Special Machinery and Apparatus designed and carried out to Specification. Every description of Accurate work. Repetition work with all parts interchangeable.

SCIENCE EXAMINATIONS.

For LONDON and other UNIVERSITIES, the
CONJOINT BOARD, &c.

Well-equipped LABORATORIES, DAY AND EVENING. Personal or Class Tuition.

"R." 9 Heathcote Street, Gray's Inn Road, W.C.

TECHNICAL COLLEGE,
HUDDERSFIELD.

PRINCIPAL: S. G. RAWSON, D.Sc.

Applications are invited not later than January 15th for the ASSISTANT LECTURESHIP in the Physics Department. Salary, £100 per annum. Further particulars upon application.

THOS. THORP, Secretary.

VICTORIA UNIVERSITY.

THE YORKSHIRE COLLEGE, LEEDS.

DEPARTMENT OF SCIENCE, TECHNOLOGY AND ARTS.

The next Term begins Wednesday, January 10th. Prospectus (post free) from the REGISTRAR.

ALBERT EDWARD JAMRACH

(Late CHARLES JAMRACH),

NATURALIST,

180 ST. GEORGE STREET EAST.

Implements of Savage Warfare, Idols, Sacred Masks, Peruvian Pottery, Netsukis China, Lacquers, Gongs, Shells, and other Curios.

BARGAINS IN SCIENTIFIC BOOKS.

KIRBY AND HOFFMAN.—THE BEETLE-COLLECTOR'S HANDBOOK, by Dr. E. HOFFMAN and Dr. W. E. KIRBY, with 20 Coloured Plates, containing over 500 Coloured Figures, Crown 8vo, Cloth Gilt (pub. 4s. 6d.). 2s. 9d.

The only complete recent Guide for Beetle-Collecting. The CONTENTS deal with the Structure, Development, Habits, &c., of Beetles, How to Kill them, and How to Arrange the Collection, followed by Full Accounts of the Several Species, which the 500 coloured figures represent.

"The plates contain upwards of 500 figures, and those of many of the larger species are excellent. We can recommend this work as one which is likely to induce many to collect."—*Science Gossip*.

STEWART (A., F.R.C.S.), OUR TEMPERAMENTS, THEIR STUDY AND THEIR TEACHING, a Popular Outline, large 8vo volume, with 30 Illustrations (some Coloured), including a Selection from Lodge's "Historical Portraits," showing the Chief Forms of Faces, Gilt Top (pub. 15s.). 3s.

"The book is exceedingly interesting, even for those who are not systematic students of anthropology. . . . To those who think the proper study of mankind is man, it will be full of attraction."—*Daily Telegraph*.

"The author's object is to enable a student to read a man's temperament in his aspect. The work is well adapted to its end. It is worthy the attention of students of human nature."—*Scotsman*.

CAMPBELL (D. H.), THE STRUCTURE AND DEVELOPMENT OF THE MOSSES AND FERNS (ARCHÉGONIATÆ), by DOUGLAS HOUGHTON CAMPBELL, Ph.D., fully Illustrated, Medium 8vo (pub. 14s. net). 4s.

"Dr. Campbell's book is clearly written, well illustrated, is provided with an accurate bibliography and a copious index, so that it will take its place at once as a standard classic, and will, we think, retain that position for no considerable period."—*Gardener's Chronicle*.

Postage extra.

H. J. GLAISHER, New and Remainder Bookseller, 57 Wigmore Street, London, W.

Catalogues Post Free on application.

LATEST PUBLICATION OF THE ZOOLOGICAL SOCIETY OF LONDON.

TRANSACTIONS, Vol. XV., Part IV., containing Papers on the Ichthyology of Lake Tanganyika. By G. A. Boulenger, F.R.S., F.Z.S. (with Three Plates), and "On a Specimen of *Ceratus belgrandi*, Lant (*C. verticornis*, Dawk), from the Forest-bed of East Anglia." By Sidney F. Harmer, Sc.D., F.R.S. (with One Plate). Price to Fellows, 9s.; to the Public, 12s.

To be obtained at the Society's Office, 3 Hanover Square, W., or through any Bookseller.

PHENIX FIRE OFFICE,
19 LOMBARD ST., E.C., and 57 CHARING CROSS, S.W.
ESTABLISHED 1782.

MODERATE RATES. ABSOLUTE SECURITY.
ELECTRIC LIGHTING RULES SUPPLIED.

LIBERAL LOSS SETTLEMENTS.
PROMPT PAYMENT OF CLAIMS.

FRANCIS B. MACDONALD, SECRETARY.

LOSSES PAID OVER £22,000,000.

THE AERIAL GRAPHOSCOPE (BRUCE'S PATENT).

Showing Lantern Pictures in Space and Relief without a Screen, Weird Ghost Effects and Visions, and a variety of Entirely Original Experiments on Persistence of Vision.

Exhibited at the Soirées of the Royal Society, Royal Institution, Society of Arts, London Institution, &c., &c.

The Inventor, **MR. ERIC STUART BRUCE**, M.A. Oxon., F.R. Met. Society, can accept Engagements for his Elaborately Illustrated Lecture on this complete Novelty, also for shorter Demonstrations at Soirées, Photographic Exhibitions, and other Entertainments.

APPLY TO

E. S. BRUCE, Esq.,
19 CAMPDEN HOUSE ROAD, KENSINGTON,
LONDON, W.

W. G. PYE & CO.

Physical & Physiological Instrument Makers,
30 ST. ANDREW'S STREET, CAMBRIDGE.

STUDENTS'
BRIDGE

Aggregate
Guaranteed
Platinoid



WHEATSTONE
BOX.
12,220 ohms
to 1 in 500.
Wire.

Price £9 10s., as illustrated. Smaller Boxes, from £3.

IMPROVED REFLECTING GALVANOMETER,
for use with above, any resistance to 2000 ohms, £3.

Galvanometer Shunts, Galvanometer Lamps and Scales,
Keys, Single Coils, Batteries, &c.

Reliable Apparatus at low prices for teaching Mechanics, Hydrostatics, Heat, Optics, Magnetism and Electricity, as supplied to many of the leading Technical Institutes and Organised Science Schools.

Physical and Physiological List—Sixpence, Post free.

Second Volume.

A SELECTION OF PHOTOGRAPHS OF STARS, STAR CLUSTERS, AND NEBULÆ,

Together with Information concerning the Methods employed in the Pursuit of Celestial Photography (Illustrated by 72 Photographs reproduced in Collotype),

By **ISAAC ROBERTS, D.Sc., F.R.S.**

Ready in December. Royal Quarto. Price 30s., post free.

LONDON: KNOWLEDGE OFFICE, 326 HIGH HOLBORN, W.C.

NOTICE.—FINAL NOTICE respecting the NATURE RE-ISSUE OF SOWERBY'S ENGLISH BOTANY.

THIRD EDITION, WITH SUPPLEMENT
AT THE PRESENT LOW PRICE.

THIRTEEN VOLUMES.

CONTAINING a DESCRIPTION and a HAND-
COLOURED LIFE-SIZE DRAWING OF
EVERY BRITISH PLANT.

PUBLISHERS' PRICES.

(1900.)

Cloth Binding £25 0 0
Half-Morocco £27 10 0

BY INSTALMENT.

(TO-DAY.)

Cloth Binding £16 16 0

FOR CASH.

(TO-DAY.)

Cloth Binding £16 0 0

HALF-MOROCCO SETS ALL SOLD.

SOWERBY'S ENGLISH BOTANY.

For over 100 years A STANDARD AUTHORITY.

- (1) Is illustrated by nearly two thousand beautiful hand-coloured Plates.
- (2) Contains a technical description of each plant, with a popular sketch by Mrs. LANKESTER.
- (3) Is completed by an Index of over one hundred pages, with (a) Botanical names, (b) common English names, (c) Synonyms, (d) French and German equivalents.

Copies of the Book may be seen at NATURE Office, St. Martin's Street, W.C. An explanatory pamphlet, giving specimen pages, full contents, extracts from the preface, with a sample illustration and order form, will be sent Post free on application to

C. WORSFOLD, NATURE Office,
St. Martin's Street, London, W.C.

CONTENTS.

VOL. I.—All the Plants ranked under the orders Ranunculaceæ, Berberidaceæ, Nymphæaceæ, Papaveraceæ, and Crucifereæ.

VOL. II.—All the Plants ranked under the orders Resedaceæ, Cistaceæ, Violaceæ, Droseraceæ, Polygalaceæ, Frankeniaceæ, Carophyllaceæ, Portulacaceæ, Tamariscaceæ, Elatinaceæ, Hypericaceæ, Malvaceæ, Tiliaceæ, Linaceæ, Geraniaceæ, Illiciaceæ, Celastraceæ, Rhamnaceæ, Sapindaceæ.

VOL. III.—All the Plants ranked under the orders Leguminifereæ and Rosaceæ.

VOL. IV.—All the Plants ranked under the orders Lythraceæ, Onagraceæ, Cucurbitaceæ, Grossulariaceæ, Crassulaceæ, Saxifragaceæ, Umbellifereæ, Araliaceæ, Cornaceæ, Lorantheaceæ, Caprifoliaceæ, Rubiaceæ, Valerianaceæ, and Dipsaceæ.

VOL. V.—All the Plants ranked under the order Compositæ.

VOL. VI.—All the Plants ranked under the orders Campanulaceæ, Ericaceæ, Jasminaceæ, Apocynaceæ, Gentianaceæ, Polemoniaceæ, Convolvulaceæ, Solanaceæ, Scrophulariaceæ, Orobanchaceæ, and Verbenaceæ.

VOL. VII.—All the Plants ranked under the orders Labiata, Boraginaceæ, Lentibulariaceæ, Primulaceæ, Plumbaginaceæ, Plantaginaceæ, Paronychiaceæ, and Amarantaceæ.

VOL. VIII.—All the Plants ranked under the orders Chenopodiaceæ, Polygonaceæ, ELEGANCEæ, Thymelaceæ, Santalaceæ, Aristolochiaceæ, Empetraceæ, Euphorbiaceæ, Callitrichaceæ, Ceratophyllaceæ, Urticaceæ, Amentifereæ, and Conifereæ.

VOL. IX.—All the Plants ranked under the orders Typhaceæ, Araceæ, Lemnaceæ, Naiadaceæ, Alismaceæ, Hydrocharidaceæ, Orchidaceæ, Iridaceæ, Amaryllidaceæ, Dioscoreaceæ, and Liliaceæ.

VOL. X.—All the Plants ranked under the orders Juncaceæ and Cyperaceæ.

VOL. XI.—All the Plants ranked under the order Graminaceæ.

VOL. XII.—Marsiliaceæ, Isoetaceæ, Selaginellaceæ, Lycopodiaceæ, Ophioglossaceæ, Filices, Equisetaceæ, and Characeæ; and an Index to the whole Work.

VOL. XIII. (SUPPLEMENT).—Addenda to the earlier portion of the Work, including all the orders in Vols. I. to IV.

SPECIAL OFFER WITHDRAWN JANUARY 1, 1900.

A few late orders may be received till January 3, 1900.

ORDER FORM FOR MONTHLY PAYMENTS.

Date..... 1899.

All cheques should be crossed and made payable to C. Worsfold, NATURE Office, St. Martin's Street, W.C.

I enclose One Guinea as first payment for a copy of "Sowerby's English Botany" bound in Cloth, Sixteen Guineas, and I agree to pay to you, or to your representative, the balance at the rate of One Guinea per month; my next payment to be on the delivery of the volumes, and my remaining payments on the corresponding day of each month following.

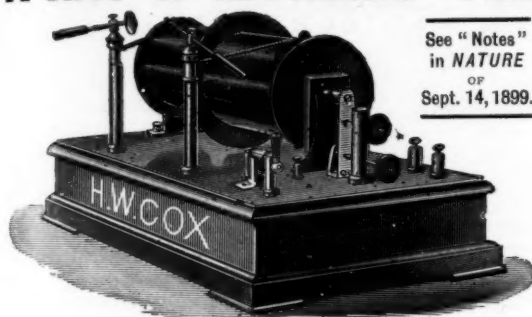
Until such payments are complete, I engage that the Work, not being my property, shall not be disposed of by sale or otherwise. I further agree that if it be found impossible for any reason to deliver the book, the return of the sum of One Guinea to me shall cancel this agreement.

Name

Address

Residents abroad are kindly requested to remit in full, or to instruct their representatives in England to make the monthly payments, in order to avoid expense and delay in forwarding cash from abroad.

X-RAY & ÆTHERIC TELEGRAPHY APPARATUS



See "Notes"
in NATURE
OF
Sept. 14, 1899.

OF THE HIGHEST QUALITY AND FINISH ONLY.
As supplied by us to H.M. Government and the leading
Hospitals and X-Ray Workers throughout the World.

We are the actual Manufacturers, and Guarantee
every Coil against breaking down.

CALL OR WRITE FOR OUR NEW ILLUSTRATED LIST, WITH
TESTIMONIALS AND ILLUSTRATED INSTRUCTIONS UPON HOW
TO WORK. POST FREE TO READERS OF "NATURE."

HARRY W. COX, Ltd.,
10, 11, 28 CURSITOR STREET,
CHANCERY LANE, LONDON.

Radiographs taken for Scientific and Medical Men, and
Demonstrations given.

PATENTS.

JAMES G. LORRAIN, M.I.E.E., M.I.MECH.E., &c.,
CHARTERED PATENT AGENT,
Norfolk House, Norfolk Street, LONDON, W.C.

Speciality—**PHYSICAL PATENTS,**
OPPOSITIONS, AND AMENDMENTS.

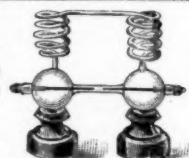
Charges on Application.
Telephone No. 2511 GERRARD. Telegrams: "LORRAIN, LONDON."
"Patentees' Handbook" Post free on application.

GLASS BLOWING.

All kinds of Experimental Glass
Blowing carried out for Scientific
Men, Laboratories, &c.

INVENTORS' IDEAS WORKED OUT AS PER INSTRUCTIONS.

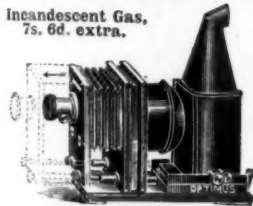
COSSOR,
67 FARRINGTON ROAD, E.C.



Hittorff's Tube showing the
resistance of the dark space.

"OPTIMUS" CANTILEVER PHOTOGRAPHIC ENLARGER.

Incandescent Gas,
7s. 6d. extra.



This already popular model
is finished in a very superior
and practical style. The lamp
gives a brilliant and even light.
The optical system is through-
out the best. *The Lens will
be found to give a very flat
field and good marginal defini-
tion.*

* SUITED FOR POCKET
CAMERA NEGATIVES.

Diam. of Condenser ...	4in.	5in.	6in.	8in.	10in.
Price, no Front Lens ...	62/-	70/-	80/-	110/-	200/-
Extra for Front Lens ...	27/-	27/-	37/-	63/-	63/-
Covering Plates ...	3 1/2 x 3 1/2	4 1/2 x 3 1/2	6 1/2 x 4 1/2	8 1/2 x 5 1/2	

Catalogue POST FREE.

PERKEN, SON & RAYMENT,

HARVEY & PEAK

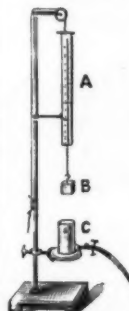
HAVE FOR DISPOSAL

A VERY LARGE AND RARE PROJECTION POLARISCOPE.

Including Nicol Polariser of 3 1/2 inches aperture, Nicol Analyser of 3 1/4 inches aperture,
many large Sections of Quartz, Quartz Devices, Crystals, Double Image Prisms,
Selenites, &c., in Mahogany Cabinets.

56 CHARING CROSS ROAD, LONDON, W.C.

MOORE'S HYDROSTATIC BALANCE



FOR ILLUSTRATING THE "PRINCIPLE OF
ARCHIMEDES" AND SPECIFIC GRAVITY.

A is a delicate spring balance accurately graduated to
read Grams, and is capable of being lowered or raised
by the string shown.

B is one of the set of cubes of various metals supplied
with the apparatus.

C is a glass vessel with fixed mark etched in glass, up
to which water, or other liquid, is placed. The
vessel is provided with draw-off cock.

Sole Makers of this Apparatus—

BREWSTER, SMITH, & CO.,
6 CROSS STREET, FINSBURY, E.C.

Manufacturers and Importers of Chemical and Scientific
Apparatus and Pure Chemicals.

WEIGHTS a Speciality, 500 Milligrams to
1 Milligram, 1s. 6d. per doz.

SEND FOR COMPLETE ILLUSTRATED
CATALOGUE.

"OPTIMUS" MAGIC LANTERNS FOR DRAWING ROOM AND LECTURE HALL.

Each Lantern is efficient for Exhibitions.
The Lens gives crisp definition, being a
superior Achromatic Photographic Combination,
with Rack and Pinion, compound Compound
Condenser of 4in. diameter. Each has 3-wick
Refugent Lamp, and is Complete in box.
(4-wick Lamp, 2s. extra.)



Mahogany outside Body, Panelled Door,
Brass Stages, and 3-draw Sliding Tubes, so
that lenses of long focus may be used when
projecting upon a screen at a great distance, £5 5s.

Mahogany outside Body, lined with metal, making a
thoroughly practical instrument, and really good value ... £2 12 0

Russian Iron Body, Brass Sliding Tubes (Educational)... 3 3 0

Do. do. (College) ... 2 8 0

99 HATTON GARDEN,
HOLBORN CIRCUS, E.C. **LONDON.**

ISENTHAL, POTZLER & CO.,
85 MORTIMER STREET, LONDON, W.
CENTRAL DEPOT FOR RADIOGRAPHERS.

Telegrams :
"HYSTERESIS."



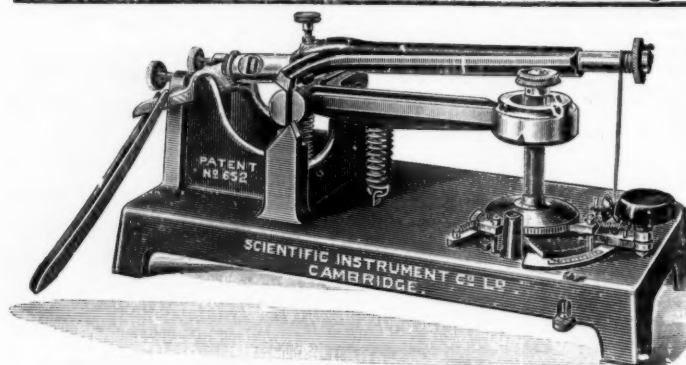
Telephone :
2099, GERRARD.

THE "PUNKTOGRAPH."

WRITE FOR LISTS, OR BETTER INSPECT OUR INSTALLATIONS.
HIGHEST REFERENCES. EVERYTHING NOVEL AND ORIGINAL.

SOLE AGENTS FOR SCOTLAND :

Messrs. JAMES WHITE, Cambridge Street, Glasgow.



THE CAMBRIDGE
SCIENTIFIC INSTRUMENT CO.,
LTD., CAMBRIDGE.

NEW ROCKING MICROTOME.
1900 PATTERN. [PATENTED.]

This Instrument possesses the following great improvements over the old type of instruments :—
(1) Increased rigidity. (2) The impossibility of cutting thin and thick sections. (3) The impossibility of tearing sections on the upward movement of the object. (4) A graduated arc for showing the thickness of the sections. (5) Catch for holding the object above the edge of the razor. (6) Improved method of fixing the cord. (7) A new object holder.

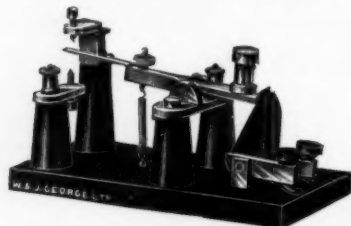
PRICE (including object-holder), £5 0 0
Write for Pamphlet descriptive of the above Instrument.
Address all communications :—
INSTRUMENT COMPANY, CAMBRIDGE.

"NIVOC" SPECIALITIES.

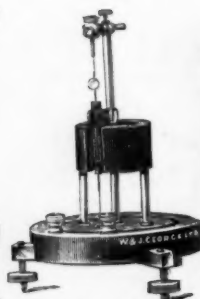
WORKS—BIRMINGHAM.

Buy direct from the Manufacturers.

THESE INSTRUMENTS ARE SPECIALLY
SUITED FOR WORKING TOGETHER.



KEMPE'S CHARGING & DISCHARGING KEY.
Improved Form with rubbing contacts, highly insulated, £3 15s. Highest quality and finish.
Late F. E. BECKER & CO.)



"NIVOC" MOVING COIL GALVANOMETER
BALLISTIC, very sensitive. To work with $\frac{1}{2}$ Micro-Farad Condenser, £2 10s.



STANDARD CONDENSER, $\frac{1}{2}$ Micro-Farad, £2 12s. 6d.

STANDARD CLARK CELL, 25s. net.

W. & J. GEORGE, LTD., 33-37 HATTON WALL, LONDON.

THE BRIDGES-LEE PHOTO-THEODOLITE

The most perfect Instrument
invented for Survey Work in
Mountainous Districts, and for
Military or Rapid Surveys.

The Photo-Theodolite
automatically records
on the photograph all,
or nearly all, the data
necessary for the reduction
of the photographs,
including the Magnetic
bearings, — thus con-
siderably reducing the
time spent and the risk
of error in the interpretation of
the photographs.

The Instrument is fitted with
an Aluminium Body, 6-in.
Azimuthal Circle, reading with
Vernier to one minute of arc,
4-in. Compass, divided to half
degrees. Telescope with erect
and inverting Eye-pieces, rapid
Rectilinear Lens with Iris Dia-
phragm and Colour Screen, six double dark Slides in Mahogany
Case, with Stand complete, **£45.**

Descriptive Pamphlets and Illustrated Description
of the Instrument sent free on application.

AGENT FOR RICHARD FRERES' AUTOMATIC RECORDING INSTRUMENTS.

L. CASELLA,

147 Holborn Bars, London, E.C.

Telegraphic Address: "Escutcheon, London." Telephone: Holborn 1054.

NEW SCIENCE LANTERN.



The Universal Science Lantern has been devised for the projection of
experiments. In the short box in front of the lantern is a hinged mirror,
so placed that by the movement of a stud it may be introduced and placed
at an angle of 45 degrees with the parallel beam. The beam is thus sent
upwards through a horizontal convergent lens, on which a slide or horizontal
piece of apparatus can be placed. Above this is the objective mounted on
a brass pillar, and above the objective a prism or mirror (if the screen is
elevated above the lantern plain prisms are required for each beam), silvered
on the outside so that there is no double reflection. The mirror can be
adjusted to any angle, and is intended to send the image in an approxi-
mately horizontal direction to the screen. Slides can also be directly
projected in the usual way.

The base-board is made to fold so that the lantern can be packed into a
box 18½ x 8½ x 4½ with all its accessories *in situ*.

Price Complete, in Travelling Box, **£9 0 0**

REYNOLDS & BRANSON, LTD.

14 COMMERCIAL STREET, LEEDS.

CARL ZEISS,

MANUFACTURER OF

MICROSCOPES; TELESCOPES (ASTRONOMICAL
and TERRESTRIAL); PRISM FIELD GLASSES;
TELEMETERS; PHOTOGRAPHIC OBJECTIVES;
and OPTICAL MEASURING INSTRUMENTS,
including COMPARATORS, REFRACTOMETERS,
BUTTER-REFRACTOMETERS, SPECTRO-
METERS, &c.

LONDON BRANCH:

29 MARGARET ST., CAVENDISH SQUARE, W.

Telegrams:—DIACINIC, London.

CATALOGUES POST FREE. KINDLY SAY WHICH REQUIRED.

SOLAR AND STELLAR SPECTROSCOPES.

Evershed's Solar Spectroscopes (specially
Designed by J. EVERSHED, F.R.A.S., for the Observation of Solar
Protuberances.)

Disc Prisms, for Use in Front of a Telescope
Object-Glass for Stellar Spectroscopy and Eclipse Work
And all other requirements for Celestial Spectroscopy.

FOR THE ECLIPSE. Film reproductions of
ROWLAND'S Gratings adapted to Hand Telescopes or Binoculars of
any kind, for Observation of the Sun at the Flash Point. The
Spectrum from A to H is more than 20". The Grating is on a Prism,
which is Mounted in a Cap with Eyepiece, which can be put on or
taken off in an instant.

PRICE from 35s.

ADAM HILGER, 204 Stanhope St., London, N.W.

FREDK. JACKSON & CO.

(Late MOTTERSHEAD & CO.).

14 CROSS STREET, MANCHESTER.

Goods Entrance: 10 Half-Moon Street,

LABORATORY FURNISHERS,
Importers, Manufacturers, and Dealers in
**CHEMICAL AND PHYSICAL
APPARATUS**

Of every Description.

Fine Chemicals, Volumetric Solutions,
Plain and Stoppered Bottles,

AND EVERY LABORATORY REQUIREMENT.

Illustrated Catalogue of Apparatus, with Price List
of Chemicals, free on application.

Telegraphic Address—"APPARATUS, MANCHESTER."

Telephone Number—2038.

Apparatus for estimation of sulphur in spent oxide.



T. TAMBLYN-WATTS, SCIENTIFIC APPARATUS MAKER.

Catalogue of Electrical Apparatus and Materials, 6d. Post free.

Catalogue of Balances and Weights, Apparatus for the Study
of Mechanics, &c., 6d. Post free.

GOLDIELANDS, SETTLE, YORKS.

SECOND-HAND MICROSCOPES

By SWIFT, WATSON, CROUCH, BECK, ZEISS, LEITZ, &c.
Prices from **£2 10s. to £45.**

A Large Selection of Second-hand Powers and Fittings for all kinds of
Microscopes.

Send for New List.

CLARKSON & CO., 28 Bartlett's Buildings, Holborn Circus, E.C.

HOLLOWAY'S OINTMENT CURES

Gout, Rheumatism, Lumbago, Sciatica, Cuts, Bruises, Sprains, &c.

INVALUABLE FOR ALL SKIN DISEASES.

Holloway's Ointment and Pills may be obtained of all Medicine Vendors.

THE IRISH NATURALIST. A Monthly Magazine of Irish Zoology, Botany, and Geology. Price 6d.

Edited by GEO. H. CAPEPENTER, B.Sc., and R. LLOYD PRÆGER, B.A.

Annual Subscription, 5s. Post Free to any Address.

Dublin: EASON & SON, LTD., 40 Lower Sackville Street (to which Address Subscriptions should be sent).

London: SIMPKIN, MARSHALL, HAMILTON, KENT, & CO., Ltd.

THE ENTOMOLOGISTS' MONTHLY MAGAZINE.

Price Sixpence, Monthly.

Edited by C. G. BARRETT, G. C. CHAMPION, F.Z.S., J. W. DOUGLAS W. W. FOWLER, M.A., F.L.S., R. McLACHLAN, F.R.S., E. SAUNDERS F.L.S., and

LORD WALSHINGHAM, M.A., LL.D., F.R.S.

This Magazine, commenced in 1864, contains standard articles and notes on all subjects connected with Entomology, and especially on the Insects of the British Isles.

Subscription—Six Shillings per Annum, post free.

London: GURNEY & JACKSON (Mr. Van Voorst's Successors), 1 Paternoster Row.

NORTH BRITISH AGRICULTURIST,

the Chief Agricultural Journal in Scotland, circulates extensively among Landowners, Farmers, Resident agents, and others interested in the management of land throughout the United Kingdom.

The AGRICULTURIST is published every Wednesday afternoon in time for the Evening Mails, and contains Reports of all the principal British and Irish Markets of the week.

The special attention of Land Agents is directed to the AGRICULTURIST as one of the best existing Papers for Advertising Farms to be Let, and Estates for Sale.

Advertisers addressing themselves to Farmers will find the AGRICULTURIST a first-class medium for reaching that Class.

Price 3d. By Post 3½d. Annual Subscription, payable in advance, 14s.

Offices—377 High Street, Edinburgh, and 145 Queen Victoria Street, London, E.C. Money Orders payable to C. and R. ANDERSON.

SCIENTIFIC WORTHIES.

The following is a list of the Steel Portraits that have appeared in the above Series:—

MICHAEL FARADAY.
THOMAS HENRY HUXLEY.
CHARLES DARWIN.
JOHN TYNDALL.
SIR GEORGE GABRIEL STOKES.
SIR CHARLES LYELL.
SIR CHARLES WHEATSTONE.
SIR WYVILLE THOMSON.
ROBERT WILHELM BUNSEN.
LORD KELVIN.
BARON ADOLF ERIK NORDENSKJÖLD.

HERMANN L. F. HELMHOLTZ.
SIR JOSEPH DALTON HOOKER.
WILLIAM HARVEY.
SIR GEORGE B. AIRY.
J. LOUIS R. AGASSIZ.
JEAN BAPTISTE ANDRÉ DUMAS.
SIR RICHARD OWEN.
JAMES CLERK MAXWELL.
JAMES PRESCOTT JOULE.
WILLIAM SPOTTISWOODE.
ARTHUR CAYLEY.
SIR C. W. SIEMENS.

JOHN COUCH ADAMS.
JAMES JOSEPH SYLVESTER.
DMITRI IVANOWITSH MENDELEEF.
LOUIS PASTEUR.

SIR ARCHIBALD GEIKIE.
LORD LISTER.
STANISLAO CANNIZZARO.
PROF. VON KÖLLIKER.
PROF. SIMON NEWCOMB.

N.B.—The Portraits of Sir A. Geikie, Lord Lister, Prof. Cannizzaro, Prof. von Kölliker, and Prof. S. Newcomb belong to a New Series and are Photographures.

Proof impressions of these, printed on India paper, may be had from the Publishers, price 5s. each; or the Series of 32 Portraits in a Handsome Portfolio for £8 5s., carriage paid. The Portfolio may be had separately, price 6s.

Cheques and Money Orders payable to MACMILLAN & CO., Limited.

OFFICE OF "NATURE," ST. MARTIN'S STREET, LONDON, W.C.

NOTICE.—Advertisements and business letters for NATURE should be addressed to the Publishers; Editorial communications to the Editor. The telegraphic address of NATURE is "PHUSIS," LONDON.

SUBSCRIPTIONS TO "NATURE."

	£	s.	d.
Yearly	1	8	0
Half-yearly	0	14	6
Quarterly	0	7	6
TO ALL PLACES ABROAD:—			
Yearly	1	10	6
Half-yearly	0	15	6
Quarterly	0	8	0

Cheques and Money Orders payable to MACMILLAN & CO., Limited.
OFFICE: ST. MARTIN'S STREET, LONDON W.C.

TO SCIENCE LECTURERS.

HUGHES' MOTO-PHOTOSCOPE FOR LIVING PICTURES.

THE MOST PERFECT.

No SHUTTER, therefore no Flickering. Superb Mechanism.

The Moto-Photo Camera for taking the Pictures. Illustrated Lists, 2d.

See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN, &c. Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great success. New Oxyhydrogen Microscope. Science Lanterns for Class Demonstration. Magnificent Results. Docwra Triple, Prize Medal, Highest Award. Supplied to the Royal Polytechnic Institution, Dr. H. GRATTAN GUINNESS, Madame ADELINA PATTI, &c., &c. Patent Pamphengos Science Lanterns. The Universal Lantern 4-inch Condensers, 4-wick Lamp, Portrait Combination front Lenses, 18s. 6d., Marvellous value. Science Lecture Sets. Novelties. The Lantern Kaleidoscope. Cheapest Lantern Outfits in the World. Grandly Illustrated Catalogue, over 180 choice Engravings, 6d.; Postage, 3d. List of 300 Lecture Sets, Science Subjects, Views, &c., 6d.; Postage 2d. Pamphlets Free. W. C. HUGHES, SPECIALIST, Brewster House, 88 Mortimer Road, Kingsland, N.

THE ENTOMOLOGIST:

AN ILLUSTRATED JOURNAL OF GENERAL ENTOMOLOGY.

Edited by RICHARD SOUTH, F.E.S.,

With the Assistance of

ROBERT ADKIN, F.E.S.

T. R. BILLUPS, F.E.S.

W. LUCAS DIBBET, F.E.S., &c.

EDWARD A. FITCH, F.L.S., F.E.S.

F. W. FROHAWK, F.E.S.

MARTIN JACOBY, F.E.S.

J. H. LEACH, B.A., F.L.S., F.E.S.

DR. D. SHARP, F.R.S., F.E.S., &c.

G. H. VERRALL, F.E.S.

W. WARREN, M.A., F.E.S.

W. F. KIRBY, F.E.S.

Founded by the late Edward Newman in 1840, this Journal has been the popular organ of British Entomologists since 1864. Its contents deal chiefly with the home fauna, but there are frequent articles and notes on matters of interest pertaining to the Entomology of various parts of the world.

Published on the first of each month. Price 6d. Subscription, 6s. per annum post free to any country.

London: WEST, NEWMAN, & CO., 54 Hatton Garden, E.C.

CO-OPERATIVE WORLD TRAVEL

Organised by **HENRY S. LUNN, M.D., F.R.G.S.,**
W. HOLDSWORTH LUNN, & CONNOP F.S. PEROWNE

A Cruise to the WESTERN MEDITERRANEAN.

TILBURY, GIBRALTAR, TANGIER, ALGIERS, PALMA, VILLE-
 FRANCHE (for NICE, CANNES, MONTE-CARLO), MARSEILLES.

A FIFTEEN DAYS' CRUISE FOR £9 9s. AND UPWARDS.**A Cruise to the EASTERN MEDITERRANEAN.**

(Return ticket to MARSEILLES included.)

MARSEILLES, SYRACUSE, PIRÆUS (for Athens),
 CONSTANTINOPLE, JAFFA (for Jerusalem), ALEXANDRIA,
 MALTA, NAPLES, MARSEILLES.

A THIRTY-FIVE DAYS' CRUISE FOR £36 15s. AND UPWARDS

s.v. *ARGONAUT*. Tonnage, 3254; h.-p., 4000.

Full particulars from the Secretary, 5 Endsleigh Gardens,
 Euston, London, N.W.

**LIVING SPECIMENS FOR
THE MICROSCOPE.**

Volvox, Spirogyra, Desmids, Diatoms, Amoeba, Arcella, Actinosphaerium,
 Vorticella, Stentor, Hydra, Floscularia, Stephanoceros, Melicerta, and many
 other Specimens of Pond Life. Price 1s. per Tube, Post Free. Helix
 pomatia, Astacus, Amphioxus, Rana, Anodon, &c., for Dissection purposes.

THOMAS BOLTON,

25 BALSALL HEATH ROAD, BIRMINGHAM.

**MARINE BIOLOGICAL ASSOCIATION
OF THE UNITED KINGDOM.****THE LABORATORY, PLYMOUTH.**

The following animals can always be supplied, either living
 or preserved by the best methods:—

Sycon; Clava, Obelia, Sertularia; Actinia, Tealia, Caryophyllia, Alcy-
 onium; Horniphora (preserved); Leptoplana; Lineus, Amphiporus; Nereis,
 Aphrodite, Arenicola, Lanice, Terebella; Lepas, Balanus, Gammarus,
 Ligia, Mysis, Nebalia, Carcinus; Patella, Buccinum, Eledone, Pecten
 Bugula, Crisia, Pedicellina, Holothuria, Astartis, Echinus; Ascidia, Salpa
 (preserved), Scyllium, Raia, &c., &c.

For prices and more detailed lists apply to
 Biological Laboratory, Plymouth.

THE DIRECTOR.

**EVERETT & CO.,
MECHANICAL ENGINEERS AND
ELECTRICIANS,**

22 CHARTERHOUSE SQUARE, E.C.

Makers of High-Grade Physical and Electrical Apparatus.

Apparatus designed and made for Laboratories and Research Work.

ALL KINDS OF EXPERIMENTAL WORK.

HIGH-CLASS WORKMANSHIP AND ACCURACY A SPECIALITY.

MODELS DESIGNED, &c.

REPAIRS OF EVERY DESCRIPTION.

THE MOST NUTRITIOUS.

E P P S'S

GRATEFUL—COMFORTING.

C O C O A

BREAKFAST—SUPPER.

BORD'S PIANOS**BECHSTEIN PIANOS**

25 per cent. Discount for Cash, or 14/6 per month (second-hand, 10/6 per
 month) on the Three Years' System. Lists free of

O. STILES & CO., 40 & 42 Southampton Row, London, W.C.

PIANOS EXCHANGED.

These magnificent Pianos for Hire on the Three Years' System at
 advantageous prices and terms. Lists and particulars free of

CHAS. STILES & CO., 40 & 42 Southampton Row,
 LONDON, W.C.

WATKINS & DONCASTER,

NATURALISTS,
 AND MANUFACTURERS OF

CABINETS AND APPARATUS

FOR ENTOMOLOGY, BIRDS' EGGS, AND ALL BRANCHES OF
 NATURAL HISTORY.

SPECIAL SHOW-ROOM FOR CABINETS.

Call or send for detailed Catalogue (66 pp.), Post free on
 application.

N.B.—For Excellence and Superiority of Cabinets and
 Apparatus, references are permitted to distinguished
 patrons, Museums, Colleges, &c.

A LARGE STOCK OF INSECTS AND BIRDS' EGGS.

Birds, Mammals, &c., Preserved and Mounted by First-class Workmen
 with true natural surroundings. All Books and Publications on Natural
 History supplied.

36 STRAND, LONDON, W.C.

(Five Doors from Charing Cross.)

MINERALS, ROCKS, AND PRECIOUS STONES.

Choice Minerals for Museums, Characteristic Examples for the Teacher,
 Student, or Prospector.

LAPIDARIES' WORK IN ALL BRANCHES.**BLOWPIPE CASES AND APPARATUS.**

LESSONS GIVEN.

SAMUEL HENSON,

97 REGENT STREET, LONDON, W.

ESTABLISHED 1840.

MINERALS, ROCKS & FOSSILS.**COLLECTIONS FOR STUDENTS.**

Carefully labelled and arranged in Boxes with Card Trays.

50 Minerals, 12/6; 100 do., 21/-; 200 do., 42/-.

Rocks and Fossils at similar prices.

300 Minerals in Cabinet, £4 4s.; 400 do., £5 12s. 6d.

Catalogues Post Free.

THOMAS D. RUSSELL,

78 NEWGATE STREET, LONDON, E.C.

PHYSIOGRAPHY and GEOLOGY.**COLLECTIONS & MICROSCOPIC SLIDES,**

As advised by Science and Art Directory, arranged by

JAMES R. GREGORY & CO.,

Mineralogists, &c.,

To Science and Art Department, British, Indian and Colonial
 Museums, &c.

**NOVELTIES and RARE GEMS and PRECIOUS
STONES.**

Mineral Specimens for Museums, and Collectors, and all purposes.
 Rock Specimens and Microscopic Sections of Rocks and Minerals
 cut to order.

NEW AND VALUABLE MINERAL SPECIMENS CONSTANTLY
 ARRIVING.

Stores & Offices: 1 Kelso Place, KENSINGTON, W.
 New Catalogues and Lists Free.

ESTABLISHED 1851.

BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

INVESTED FUNDS

£10,000,000.

The BIRKBECK ALMANACK, with full particulars, post free.

FRANCIS RAVENSCROFT, Manager.

MACMILLAN & CO.'S BOOKS FOR STUDENTS OF CHEMISTRY.

AN INTRODUCTION to the STUDY OF CHEMISTRY. By Prof. W. H. PERKIN, JR., Ph.D., F.R.S., and BEVAN LEAN, D.Sc., B.A. (Lond.). Globe 8vo, 2s. 6d.

CHEMISTRY FOR ORGANISED SCHOOLS OF SCIENCE. By S. PARRISH, B.Sc., A.R.C.S. (Lond.). With Introduction by Dr. FORSYTH, Globe 8vo, 2s. 6d.

INORGANIC CHEMISTRY for BEGINNERS. By Sir HENRY E. ROSCOE, F.R.S. Assisted by JOSEPH LUNT, B.Sc. Globe 8vo, 2s. 6d.

INORGANIC CHEMISTRY FOR ADVANCED STUDENTS. By Sir H. E. ROSCOE, F.R.S., and Dr. A. HARDEN. Globe 8vo, 4s. 6d.

LESSONS in ELEMENTARY CHEMISTRY, INORGANIC and ORGANIC. By Sir H. E. ROSCOE, F.R.S. Sixth Edition, thoroughly revised. Fcap. 8vo, 4s. 6d.

A TREATISE on CHEMISTRY. By Sir H. E. ROSCOE, F.R.S., and the late C. SCHORLEMMER, F.R.S. New Edition. Completely revised by Sir H. E. ROSCOE, assisted by Drs. H. G. COLMAN and A. HARDEN. Vol. I. The Non-Metallic Elements. 8vo. 21s. Vol. II. The Metals, 31s. 6d. Vol. III. Organic Chemistry. Parts I., II., IV., and VI., 21s. each. Parts III. and V., 18s. each.

CHEMICAL THEORY FOR BEGINNERS. By LEONARD DOBBIN, Ph.D., and JAMES WALKER, Ph.D., D.Sc. Fcap. 8vo, 2s. 6d.

AN INTRODUCTION TO THE SCIENCE AND PRACTICE OF QUALITATIVE CHEMICAL ANALYSIS, INORGANIC. By CHAPMAN JONES, F.I.C., F.C.S. (London and Berlin), &c. Crown 8vo, 6s.

PRACTICAL INORGANIC CHEMISTRY FOR ADVANCED STUDENTS. By CHAPMAN JONES, F.I.C., F.C.S. (London and Berlin). Globe 8vo, 2s. 6d.

PRACTICAL INORGANIC CHEMISTRY. By G. S. TURPIN, M.A. Globe 8vo, 2s. 6d.

LESSONS IN ORGANIC CHEMISTRY. Part I., Elementary. By G. S. TURPIN, M.A., D.Sc. 2s. 6d.

The RISE and DEVELOPMENT of ORGANIC CHEMISTRY. By CARL SCHORLEMMER, LL.D., F.R.S. Revised Edition. Edited by A. SMITHELLS, B.Sc. Crown 8vo, 5s. net.

A TEXT-BOOK of INORGANIC CHEMISTRY. By Prof. IRA REMSEN. 8vo, 16s.

INORGANIC CHEMISTRY. By Prof. I. REMSEN. Crown 8vo, 6s. 6d.

ORGANIC CHEMISTRY. By Prof. I. REMSEN. Crown 8vo, 6s. 6d.

THE ELEMENTS of CHEMISTRY. By Prof. I. REMSEN. New Edition. Fcap. 8vo, 2s. 6d.

A JUNIOR COURSE of PRACTICAL CHEMISTRY. By FRANCIS JONES, F.R.S.E., F.C.S. With a Preface by Sir H. E. Roscoe, F.R.S. Eighth Edition. Globe 8vo, 2s. 6d.

AN ELEMENTARY TEXT-BOOK OF CHEMISTRY. By Prof. W. G. MIXTER. Second Edition. Crown 8vo, 7s. 6d.

THE OWENS COLLEGE COURSE OF PRACTICAL ORGANIC CHEMISTRY. By J. B. COHEN, Ph.D. Fcap. 8vo, 2s. 6d.

INORGANIC CHEMICAL PREPARATIONS. By FELIX LENGFELD. Globe 8vo, 2s. 6d. net.

EXPERIMENTAL PROOFS of CHEMICAL THEORY for BEGINNERS. By WILLIAM RAMSAY, Ph.D., F.R.S. Second Edition. Pott 8vo, 2s. 6d.

THE GASES of the ATMOSPHERE. By WILLIAM RAMSAY, F.R.S. Extra Crown 8vo, 6s. net.

THE ELEMENTS of ELECTRO-CHEMISTRY. By Professor MAX LE BLANC. Translated by W. R. WHITNEY. Globe 8vo, 6s.

A DICTIONARY of CHEMICAL SOLUBILITIES, INORGANIC. By A. M. COMEY, Ph.D. Demy 8vo, 15s. net.

ANALYTICAL CHEMISTRY. By A. MENSCHUTKIN. Translated from the third German Edition, under the supervision of the Author, by JAMES LOCKE. Medium 8vo, 17s. net.

ESSAYS in HISTORICAL CHEMISTRY. By T. E. THORPE, F.R.S. Crown 8vo, 8s. 6d. net.

OUTLINES of GENERAL CHEMISTRY. By Prof. WILHELM OSTWALD. Translated by J. WALKER, D.Sc., Ph.D. 8vo, 10s. net.

The SCIENTIFIC FOUNDATIONS OF ANALYTICAL CHEMISTRY TREATED IN AN ELEMENTARY MANNER. By WILHELM OSTWALD, Ph.D. Translated by GEORGE MACGOWAN, Ph.D. Crown 8vo, 5s. net.

MANUAL of PHYSICO-CHEMICAL MEASUREMENTS. By Prof. W. OSTWALD. Translated by JAMES WALKER, D.Sc., Ph.D. Illustrated 8vo, 7s. net.

INTRODUCTION TO PHYSICAL CHEMISTRY. By JAMES WALKER, D.Sc., Ph.D., Professor of Chemistry in University College, Dundee. 8vo, 10s. net.

LABORATORY MANUAL EXPERIMENTS TO ILLUSTRATE THE ELEMENTARY PRINCIPLES OF CHEMISTRY. By H. W. HILLYER, Ph.D. Medium 3vo, 4s. net.

A LABORATORY MANUAL OF ORGANIC CHEMISTRY. By Dr. LASSAR-COHN. Translated by A. SMITH, B.Sc., Ph.D. Crown 8vo, 8s. 6d.

CHEMICAL ARITHMETIC. With 1200 Problems. By S. LUPTON, M.A. 2nd Edition, revised. Fcap. 8vo, 4s. 6d.

The ARITHMETIC of CHEMISTRY. By JOHN WADDELL, B.Sc., Ph.D. Globe 8vo, 4s. net.

NOTES on OBSERVATIONS. Being an Outline of the Methods used for Determining the Meaning and Value of Quantitative Observations and Experiments in Physics and Chemistry, and for reducing the results obtained. By SYDNEY LUPTON, M.A. Crown 8vo, 3s. 6d.

CHEMICAL ANALYSIS OF OILS, FATS, WAXES, and OF THE COMMERCIAL PRODUCTS DERIVED THEREFROM. Founded on BENEDIKT's Second Edition of "Analyse der Fette." By J. LEWKOWITSCH, F.I.C., F.C.S. Second thoroughly revised and enlarged edition. Demy 8vo, 25s. net.

SYSTEMATIC SURVEY of THE ORGANIC COLOURING MATTERS. By Dr. G. SCHULTZ and P. JULIUS. Translated and Edited by A. G. GREEN, F.I.C., F.C.S. Royal 8vo, 21s. net.

A HISTORY of CHEMISTRY from EARLIEST TIMES TO THE PRESENT DAY. Being also an Introduction to the Study of the Science. By Professor ERNST VON MEYER, Ph.D. Translated by GEORGE M'GOWAN, Ph.D. Second English Edition. 8vo, 15s. net.

MACMILLAN AND CO., LIMITED, LONDON.

MACMILLAN & CO.'S NEW BOOKS.

VOLUME II. NOW READY.

THE SCIENTIFIC MEMOIRS OF THOMAS HENRY HUXLEY.

Edited by Prof. Sir MICHAEL FOSTER, K.C.B., and Prof. E. RAY LANKESTER, M.A., LL.D.

In Four Volumes. Vol. I., 25s. net. Vol. II. With PORTRAIT. Super Royal 8vo, 30s. net.

* * Sold in Sets only.

NEW WORK BY GOLDWIN SMITH.

THE UNITED KINGDOM: a Political History. By GOLDWIN SMITH, D.C.L.,

Author of "The United States," &c. In Two Vols. 8vo, 15s. net.

DAILY CHRONICLE.—"We receive his two volumes of continuous and accurate survey as the outcome of a learned leisure and ample authority. . . Mr. Goldwin Smith writes strong and nervous English, and he marshals his facts with scrupulous care."

THE NEW DEMOCRACY: A Political Study. By W. JETHRO BROWN, M.A.,

LL.D., &c. Demy 8vo, 7s. 6d.

BY FIELD-MARSHAL LORD ROBERTS.

THIRTIETH EDITION. Extra Crown 8vo, 10s. net.

FORTY-ONE YEARS IN INDIA. FROM SUBALTERN TO COMMANDER-

IN-CHIEF. By Field-Marshal the Right Hon. LORD ROBERTS of Kandahar, V.C., K.P., G.C.B. Containing Forty-four Illustrations and Plans.

THE WAR IN SOUTH AFRICA.

Third Edition, with a new Prefatory Chapter, dealing with the events which have induced the present Crisis.

IMPRESSIONS OF SOUTH AFRICA. By the Right Hon. JAMES Bryce, M.P.

With Three Maps, and with the Text of the Transvaal Conventions of 1881 and 1884. Crown 8vo, 6s.

NEW AND CHEAPER EDITION NOW READY.

SOUTH AFRICA OF TO-DAY. By Captain FRANCIS YOUNGHUSBAND, C.I.E.,

Indian Staff Corps, late Special Correspondent of the *Times* in South Africa. With Illustrations. Crown 8vo, 6s.

MANUALS OF MEDICINE AND SURGERY.

A MANUAL OF SURGERY. By CHARLES STONHAM, F.R.C.S. Eng., Senior

Surgeon to the Westminster Hospital; Lecturer on Surgery and on Clinical Surgery, and Teacher of Operative Surgery, Westminster Hospital; Surgeon to the Poplar Hospital for Accidents; late Member of the Board of Examiners in Anatomy under the Conjoint Scheme for England, &c. In Three Vols. Extra Crown 8vo.

Vol. I. GENERAL SURGERY. 7s. 6d. net.

Vol. II. INJURIES. 7s. 6d. net.

Vol. III. REGIONAL SURGERY. 10s. 6d. net.

INTRODUCTION TO PHYSICAL CHEMISTRY. By JAMES WALKER, D.Sc.,

Ph.D., Professor of Chemistry in University College, Dundee. 8vo, 10s. net.

EXPERIMENTAL SCIENCE (PHYSIOGRAPHY, SECTION I).—An Ele-

mentary Course of Physics and Chemistry adapted to the Syllabus of the Science and Art Department. By R. A. GREGORY, Oxford University Extension Lecturer, Professor of Astronomy, Queen's College, London, and A. T. SIMMONS, B.Sc. (Lond.), Associate of the Royal College of Science, London. Globe 8vo. 2s. 6d.

EDUCATIONAL NEWS.—"We have much pleasure in calling the attention of students to this excellent manual."

THE PHYSICAL REVIEW.

A JOURNAL OF EXPERIMENTAL AND THEORETICAL PHYSICS.

Conducted by EDWARD L. NICHOLS, ERNEST MERRITT, and FREDERICK BEDELL.

No. 4. Vol. IX. OCTOBER 1899. PRICE 3s. net.

CONTENTS:

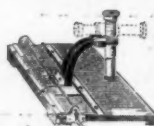
On the Magnetic Shielding Effect of Tri-lamellar Spherical and Cylindrical Shells. By A. P. WILLS.—A New Respiration Calorimeter and Experiments on the Conservation of Energy in the Human Body. II. By W. O. ATWATER and E. B. ROSA.—New Books.—Notes.

MACMILLAN AND CO., LIMITED, LONDON.

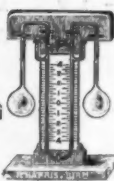


HARRIS'S ORIGINAL PATTERN ATWOOD MACHINE, 2012A, Accurate and Reliable, 8 to 9 feet high, Graduated, £3 15s.

HARRIS'S SPECIALITIES.—CATALOGUES UPON APPLICATION.



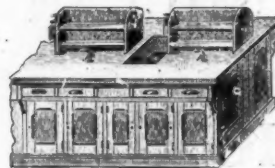
Vernier Microscope, 716A, £2 2s. 6d.



Registered Differential Thermometer, 6287A, 15s. 6d.



New Cathetometer, 187C, £5 1s. 6d.



Drawing Model

Complete Laboratory Furnishing.

ESTIMATES FREE.

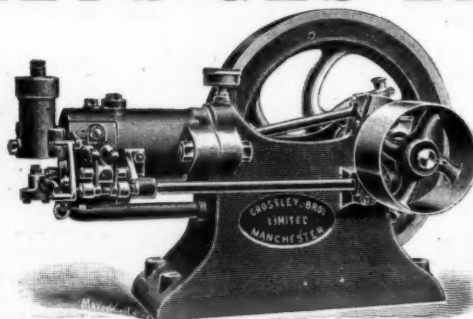
Telegraphic Address : "Science," Birmingham Telephone No. 10.

PHILIP HARRIS & Co., LTD.,

COMPLETE LABORATORY FURNISHERS, BIRMINGHAM.

CROSSLEY'S GAS ENGINES.

RECENTLY
REMODELLED.



GREAT
REDUCTION
IN
GAS
CONSUMED.

CROSSLEY BROS., LTD., OPENSHAW, MANCHESTER.

WATSON'S NEW MICROSCOPES AND APPARATUS.



WATSON'S HOLOSCOPIC EYEPIECES, for use with either APOCHROMATIC or ACHROMATIC OBJECTIVES, an adjustment being provided to the special lenses employed, for altering the correction. There is no sacrifice of efficiency, the performance being equal to the most expensive Compensating or Huyghenian Oculars.

Magnifying Powers—

6 in. tube length, 5, 7, 10, and 14 diameters.
10 in. " 7, 10, 14, and 20 "

PRICE, in Student's Size and Pattern, either power, 17/6 each.

For Full Particulars see Supplemental List, Post Free.

WATSON'S Parachromatic OIL IMMERSION CONDENSER.

Total aperture, 1'30; aplanatic aperture exceeds 1'25. Undoubtedly the finest Condenser obtainable for high-power work. Optical part only ... £5 0 0

Completely mounted with Iris Diaphragm and Set of Stops ... £8 10 0

WATSON'S "SCHOOL" MICROSCOPE, New Model, complete with 1 in. Objective, in Case ... £3 3 0

WATSON'S "ROYAL" MICROSCOPE. A new model high-class instrument.

WATSON'S "FRAM" MICROSCOPE. A highest-class instrument at a very moderate cost.

BACTERIOLOGICAL APPARATUS. MICROTOMES. Apparatus for FIELD BOTANY and FIELD GEOLOGY. METAMORPHOSES and DISSECTED PREPARATIONS. BOTANICAL and PHYSIOLOGICAL MODELS.

For Particulars of all the above, see Watson's New Supplemental List to Catalogue No. 2, Post Free on application.

Watson's Catalogue (No. 3) is a Classified List representing a Stock of 40,000 first-class Micro-Slides, Post free on application.

W. WATSON & SONS (Established 1837), Opticians to H.M. Government.

313 HIGH HOLBORN, LONDON, W.C. New Branch Now Open : 16 FORREST ROAD, EDINBURGH. And at 78 Swanston Street, Melbourne, Australia. Awarded 39 Gold and other Medals at the principal International Exhibitions of the World.



DALLMEYER'S POPULAR HAND CAMERA.

PRICE
£7 7s.

Twelve 1-plates in sheaths, instantaneous changing, rack focussing, ever-set shutter with speed regulator, mahogany body covered good leather, and fitted with a **STIGMATIC LENS**, working at f. 7.5.

Send for fully Illustrated List of Lenses and Cameras.

J. H. DALLMEYER, Ltd., 25 Newman St., LONDON, W.

Printed by RICHARD CLAY AND SONS, LIMITED, at 7 & 8 Bread Street Hill, Queen Victoria Street, in the City of London and published by MACMILLAN AND CO., LIMITED, at St. Martin's Street, London, W.C., and THE MACMILLAN COMPANY, 66 Fifth Avenue, New York.—THURSDAY, Dec. 28, 1899.

GENERAL LIBRARY,
UNIV. OF MICH.
JAN 17 1900



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

NO. 1575, VOL. 61]

THURSDAY, JANUARY 4, 1900.

[PRICE SIXPENCE.

Registered as a Newspaper at the General Post Office.]

[All Rights are Reserved.

WIRELESS TELEGRAPHY.



THE "APPS-NEWTON" INDUCTION COILS
made entirely in the London Workshops of
NEWTON & CO.,
3 FLEET STREET, E.C.,
are now used by all the principal Military, Naval and
Commercial experts in Wireless Telegraphy, as well as in
Radiography.

NEW DOUBLE-SURFACE CONDENSER

(CRIBB'S PATENT).

Large Condensing Surfaces.
Small size of Condenser. Small weight.
Great Efficiency.

EQUAL TO A LIEBIG CONDENSER FIVE
TIMES ITS SIZE.

SOLE MAKERS of the Metal Condensers:

JOHN J. GRIFFIN & SONS, LD.,
20-26 SARDINIA STREET, LONDON, W.O.

A HISTORY OF ASTRONOMY.

By **ARTHUR BERRY, M.A.,**

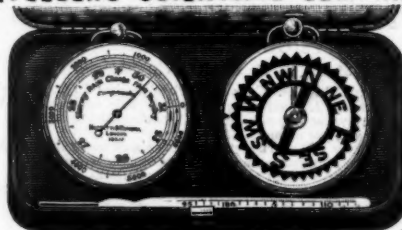
Fellow of [King's] College, [Cambridge].

With very numerous Illustrations. Crown 8vo, 6s.

"Conveys a vast amount of information."—*Literature.*
"Supplies in a very satisfactory way a decided desideratum."—*Athenaeum.* "A work which will be of the greatest value to
all serious students of astronomy."—*Manchester Guardian.*

JOHN MURRAY, ALBEMARLE STREET, W.

NEGRETTI & ZAMBRA'S TRAVELLER'S SCIENTIFIC COMPANION.



Consisting of Aneroid Barometer with Altitude Scale, Compass with
Luminous Dial for Night Marching, and Thermometer for Air Temperatures
(or a Clinical Thermometer may be substituted).

PRICE £4 10s. to £7 10s.

Can also be had Mounted in Gold and Silver Cases.

Useful Present for Officers on Foreign Service.

"Special" Illustrated Price List of Instruments, suitable for
Presents, free by Post to all parts of the World.

NEGRETTI & ZAMBRA,

SCIENTIFIC INSTRUMENT MAKERS TO THE QUEEN,

38 HOLBORN VIADUCT, E.C.

BRANCHES—45 CORNHILL; 122 REGENT STREET.

BACTERIOLOGY. BACTERIOLOGICAL DEPARTMENT, KING'S COLLEGE, LONDON.

Director: PROF. CROOKSHANK.

The Laboratories are open daily for **Instruction and Research** from 10 a.m. to 5 p.m. For Syllabus of Classes apply THE SECRETARY.

For Information and Advice as to the Course of Instruction to be selected, application must be made in writing to PROF. CROOKSHANK or an interview may be obtained by appointment.

SPECIAL CLASSES IN JANUARY.

Two complete Courses of Practical Instruction for Medical Practitioners, Veterinary Surgeons, Analysts, &c., will commence on January 8th.

Demonstrations to the Morning Class (Dr. NEWMAN, D.P.H.) will be given at 11 a.m., and to the Afternoon Class (Dr. NASH, D.P.H.) will be given at 2 p.m.; three days a week, with practical work daily in the Laboratory for THIRTY DAYS.

A Class for Candidates for the D.P.H. (Bacteriology) will commence on January 8th at 10 a.m., and a Time Table arranged to suit the convenience of the Class.

A Class in Clinical Bacteriology, consisting of Demonstrations with practical work, will commence on Wednesday, January 10th (2 to 3.30), and be held on successive Wednesdays for six weeks.

THE LONDON SCHOOL OF TROPICAL MEDICINE

(UNDER THE AUSPICES OF HER MAJESTY'S GOVERNMENT),
CONNAUGHT ROAD, ALBERT DOCK, E.
IN CONNECTION WITH THE HOSPITALS OF THE SEAMEN'S
HOSPITAL SOCIETY.

The next SESSION commences on MONDAY, JANUARY 15, 1900.

A Travelling Scholarship of £300 will be offered to Students of the School. The Laboratories, Museum, Library, &c., are open daily. Lectures on Tropical Medicine, Tropical Hygiene and Surgery in the Tropics, are delivered during the Session.

Clinical Instruction is given daily in the wards of the Hospitals. Special arrangements for Board will be made for those who may desire to reside on the premises.

For Prospectus, Syllabus, and other particulars, apply to the Secretary, P. MICHELLI, Esq., Seamen's Hospital, Greenwich, S.E.

BEDFORD COLLEGE, LONDON (FOR WOMEN),

YORK PLACE, BAKER STREET, W.

SESSION 1899-1900.

The LENT TERM will begin on THURSDAY, JANUARY 18th.

Lectures are given in all Branches of General and Higher Education. A Single Course of Lectures in any Subject may be attended, or Students can enter for (I.) a University Course in Arts or Science in preparation for the Examinations for Degrees of the University of London, (II.) a College Course, (III.) a Professional Training in Teaching (prepares for the Examination for Teaching Diplomas granted by the Universities of Cambridge and London), (IV.) a Course of Scientific Instruction in Hygiene (designed to furnish women with the training for such posts as are now open to them), (V.) the Art School.

Six Laboratories are open to Students for Practical Work.

Arrangements will be made for Students who have Matriculated in January.

Students can reside in the College.

Further information on application to the PRINCIPAL.

UNIVERSITY COLLEGE, LONDON.

PHYSIOLOGICAL CHEMISTRY.

Professor E. H. STARLING, M.D., F.R.S.

The Advanced Practical Course of Physiological Chemistry will commence on Monday, January 15th, and will be held on Mondays, Wednesdays, and Fridays, at 1.30 p.m., in the Physiological Department.

Each Class will last about 2½ hours. The Laboratory will also be open at other times to members of the Class who wish to carry out special manipulations and preparations.

Fee for the Course (about 24 Classes), Two Guineas.

In connection with the above Course a Series of Ten Lectures will be given on Saturdays, at 10 a.m., on

"The Physiological Chemistry of the Carbohydrates,"

by W. A. Osborne, M.B., D.Sc.

Fee for the Lectures alone, One Guinea.

J. M. HORSEBURGH, M.A., Secretary.

THE JENNER INSTITUTE OF PREVENTIVE MEDICINE.

The next SESSION will commence on MONDAY, JANUARY 8, at 11 a.m. The Laboratories are open for Investigation and Instruction.

A Three Months' Course in systematic Bacteriology will be given. The Class will meet three times weekly, at 10 a.m.

A Full Course in Hygiene (Bacteriology, Chemistry and Sanitary Science), extending over six months, will likewise commence on the above date.

Further particulars on application to the SECRETARY,
Chelsen Gardens, S.W.

INSTRUCTION IN PURE CULTIVATION OF YEAST,

According to **HANSEN'S Methods.**

Courses for Beginners, as well as for Advanced Students, in Physiology and Technology of Fermentations—Biological Analysis of Yeast.

Manuals:—E. Chr. Hansen: "Practical Studies in Fermentation," London (Spon), 1896. Alfred Jörgensen: "Micro-organisms and Fermentation," London (F. W. Lyon), 1893.

Further Particulars on Application to the Director, ALFRED JØRGENSEN, The Laboratory, Copenhagen, V.

B.A. and B.Sc.

MATRICULATION, INTERMEDIATE, FINAL.

PREPARATION by CORRESPONDENCE and ORAL TUITION on a THOROUGHLY INDIVIDUAL SYSTEM. Fees based on success.

The STAFF includes Graduates of Oxford, Cambridge, London, and Royal Universities, Science Medalists, Prizemen, Scholars, &c.

SINGLE SUBJECTS TAKEN: Latin, Greek, French, German, Mathematics, Science, Logic, Psychology, Political Economy, &c.

For Terms, &c., address Mr. J. CHARLESTON B.A. (London and Oxon.), The Burlington Classes, 27 Chancery Lane, London, W.C.

B.A., PRELIMINARY SCIENTIFIC, B.Sc., and all other EXAMS.

QUERNMORE.

London Branches—(1) 24 CHANCERY LANE, W.C.; (2) 115 Ebury Street, EATON SQUARE, S.W.

Special Preparation by JOHN GIBSON, M.A. (First Class, Cambridge), and G. LÖLY, B.A. (First Class, London), assisted by large Staff of Specialist Tutors. Practical Laboratories. Write for particulars to Messrs. GIBSON & LÖLY, 24 Chancery Lane, W.C.

Telegrams—"Tunzelmann, London."

THE ELECTRICAL

AND

GENERAL ENGINEERING COLLEGE.

PRESIDENT—G. W. DE TUNZELMANN, B.Sc. Lond., M.I.E.E.

PRINCIPAL—J. H. REEVES, M.A. Cantab.

Present SESSION began WEDNESDAY, SEPTEMBER 27. Particulars on application to the SECRETARY, 2 and 4 Penywern Road, Earl's Court, S.W.

VICTORIA UNIVERSITY.

THE YORKSHIRE COLLEGE, LEEDS.

DEPARTMENT OF SCIENCE, TECHNOLOGY AND ARTS.

The next Term begins Wednesday, January 10th. Prospectus (post free) from the REGISTRAR.

SCIENCE EXAMINATIONS.

For LONDON and other UNIVERSITIES, the
CONJOINT BOARD, &c.

Well-equipped LABORATORIES, DAY AND EVENING. Personal or Class Tuition.

"R," 9 Heathcote Street, Gray's Inn Road, W.C.

TECHNICAL COLLEGE, HUDDERSFIELD.

PRINCIPAL: S. G. RAWSON, D.Sc.

Applications are invited not later than January 15th for the ASSISTANT LECTURESHIP in the Physics Department. Salary, £100 per annum. The SENIOR ASSISTANTSHIP in the Chemical Department is also vacant. Salary, £60 per annum. Further particulars upon application.

THOS. THORP, Secretary.

GOVERNMENT GRANT OF £4000 TO

DEFRAY THE EXPENSES OF SCIENTIFIC INVESTIGATION.—January 31 is the last day for receiving applications. Forms

may be obtained from the CLERK to the Government Grant Committee, Royal Society, Burlington House, London.

EVERETT & CO.,

MECHANICAL ENGINEERS AND
ELECTRICIANS,

22 CHARTERHOUSE SQUARE, E.C.

Makers of High-Grade Physical and Electrical Apparatus. Apparatus designed and made for Laboratories and Research Work.

ALL KINDS OF EXPERIMENTAL WORK.

HIGH-CLASS WORKMANSHIP AND ACCURACY A SPECIALITY.

MODELS DESIGNED, &c.

REPAIRS OF EVERY DESCRIPTION.

BARAINS IN SCIENTIFIC BOOKS.

TAYLOR (Dr. J. E.).—FLOWERS: their ORIGIN, SHAPES, PERFUMES, and COLOURS. Illustrated with 32 Coloured Figures by Sowerby, and 161 Woodcuts. Crown 8vo, gilt edges (pub. 7s. 6d.). 2s. 6d.

"This is an altogether charming book, full of wisdom, cheerful, simple, attractive, and informed throughout with a high purpose. Its object is to place within reach of the general public in an agreeable form the results of the most recent and comprehensive botanical research."—*Gardener's Magazine*.

— **THE PLAYTIME NATURALIST, a** Companion to the Country Rambler. With 366 well-executed engravings. Crown 8vo (pub. 5s.). 1s. 9d.

— **NATURE'S BYEPATHS, a Series of** Recreative Papers in Natural History. Crown 8vo, Cloth (pub. 3s. 6d.). 2s.

RENDU (M. LE CHANOINE), THEORY OF THE GLACIERS OF THE SAVOY, the original Text, with a Translation by ALFRED WILLS, Q.C., Supplementary Article by P. G. TAIT, M.A., and JOHN RUSKIN, D.C.L., edited, with Introductory Remarks, by GEORGE FORBES, B.A. 8vo (pub. 10s. 6d.). 2s. 6d.

The treatise, though principally of scientific value, has great interest to all Alpine climbers, the translation being made by the late president of the Alpine Club.

RIMMER (R., F.L.S.), LAND AND FRESHWATER SHELLS OF THE BRITISH ISLES, illustrated with 10 Photographs and 3 Lithographs, containing figures of all the principal Species. Crown 8vo (pub. 5s.). 1s. 9d.

Postage extra.

H. J. GLAISHER, New and Remainder Bookseller, 57 Wigmore Street, London, W.
Catalogues Post Free on application.

THE RELIQUARY AND ILLUSTRATED ARCHÆOLOGIST.

QUARTERLY, Price 2s. 6d.

THE JANUARY PART CONTAINS:

DELVES' HOUSE, RINGMER. By W. HENEAGE LEGGE. (Fifteen Illustrations.)
PIGMY FLINT IMPLEMENTS. By REGINALD A. GATTY, LL.D. (Fifteen Illustrations.)

CINERARY URNS RECENTLY DISCOVERED ON STANTON MOOR, DERBYSHIRE. By JOHN WARD, F.S.A. (Four Illustrations.)
OLD BED WAGONS OR BED WARMERS. By RICHARD QUICK. (Fifteen Illustrations.)

THE BIDDENDEN MAIDS. By GEORGE CLINCH. (Four Illustrations.)
THE CHURCH OF ST. EWAN AT BARIVAN, NAIRNSHIRE. (Five Illustrations.)

AN ANCIENT GRAVE AT BRODIE, NAIRNSHIRE. (Illustrated.)
SCULPTURED NORMAN LYMPANUM AT SISTON. (Illustrated.)
BRASS AT BROADWATER, SUSSEX. (3 Illustrations.)
CHURCH OF ST. MICHAEL ON THE HILL, BRENT TOR, DEVON. (Illustrated.)

THE KID STOOL IN HEXHAM ABBEY. (Illustrated.)
THIRTEENTH CENTURY CARVED STONE BOSSES AT HAILES ABBEY. (Illustrated.)

NOTICES OF NEW PUBLICATIONS, &c.
London: BEMROSE & SONS, Ltd., 23 Old Bailey, and Derby.

LATEST PUBLICATION OF THE ZOOLOGICAL SOCIETY OF LONDON.

TRANSACTIONS, Vol. XV., Part IV., containing Papers on the Ichthyology of Lake Tanganyika. By G. A. Boulenger, F.R.S., F.Z.S. (with Three Plates), and "On a Specimen of *Cervus belgerandi*, Lat (*C. verticoris*, Dawk), from the Forest-bed of East Anglia." By Sidney F. Harmer, Sc.D., F.R.S. (with One Plate). Price to Fellows, 9s.; to the Public, 12s.
To be obtained at the Society's Office, 3 Hanover Square, W., or through any Bookseller.

THE SCIENTIFIC ROLL AND MAGAZINE OF SYSTEMATIZED NOTES, METEOROLOGICAL SECTION.

CLIMATE: GENERAL. 4s.
CLIMATE: AQUEOUS VAPOUR. 6s. [Reprinting.
CLIMATE: BARIC CONDITION. Present Subscription Price, 10s.
The last No. is in Press.

To be followed by:
CARBONIC ACID, CHEMICAL RAYS, &c., to WIND.
O'DRISCOLL, LENNOX & CO., 10 and 12 Elephant Road, Elephant and Castle, London, S.E.

From JOHN C. NIMMO'S LIST.

THE SEMITIC SERIES.

An important New Series of Standard Handbooks on the Babylonians, Assyrians, and Allied Semitic Races of Ancient History.

Edited by **JAMES ALEXANDER CRAIG**, Professor of Semitic Languages and Literatures and Hellenistic Greek, University of Michigan, U.S.A.

THE FIRST VOLUME READY JANUARY 1900.

BABYLONIANS AND ASSYRIANS—LIFE AND CUSTOMS.

(With special reference to the Contract Tablets and Letters.)
By the Rev. A. H. SAYCE, Professor of Assyriology at Oxford.

In Crown 8vo, Cloth, Gilt Top, 5s. net each Volume.

PUBLISHER'S NOTE.—Recent scientific research has stimulated a widely increasing interest in the study of the Babylonians, Assyrians, and allied Semitic races of ancient history among scholars, students, and the general reading public. It has provided us with a picture of a hitherto unknown civilisation, and a history of one of the great branches of the human family. The object of the present series is to present, compactly and in popular scientific form, a knowledge of the more important facts in the History, Religion, Government, Jurisprudence, Language, Customs, Art, Archaeology, &c., of the peoples dealt with, in a way that will be serviceable to the reading public generally, as well as to teachers and masters of every grade, students, the clergy, and others. The series is also one that can be especially recommended as suitable for school and college libraries throughout the country, on account of the compactness and accessibility of the information presented and the high standard of accuracy maintained. The authors are selected from the most eminent authorities in Europe and America, each being a specialist in his subject. Each volume will be complete in itself, and the series, taken as a whole, will neglect no phase of the general subject. A special feature is that the authors go, in almost every instance, to the original sources for their information, and thus avoid the errors liable to arise in following those who derive their knowledge from other sources.

LIST OF THE VOLUMES:

- I. **HEBREWS. History and Government.** By Professor J. F. McCURDY, University of Toronto, Canada.
- II. **HEBREWS. Ethics and Religion.** By Professor ARCHIBALD DUFF, Airedale College, Bradford.
- III. **THE SUMERIANS. Language, History, AND RELIGION.** By Professor FRITZ HOMMEL, University of Munich, Germany.
- IV. **BABYLONIANS AND ASSYRIANS. HISTORY TO THE FALL OF BABYLON.** By Professor FRITZ HOMMEL, University of Munich, Germany.
- V. **BABYLONIANS AND ASSYRIANS. RELIGION.** By Professor J. A. CRAIG, University of Michigan, U.S.A.
- VI. **BABYLONIANS AND ASSYRIANS. Life AND CUSTOMS.** (With special reference to the Contract Tablets and Letters.) By Professor A. H. SAYCE, University of Oxford. [Ready in January.]
- VII. **BABYLONIANS AND ASSYRIANS. EXCAVATIONS AND ACCOUNT OF DECIPHERMENT OF INSCRIPTIONS.** By Professor A. V. HILPRECHT, University of Pennsylvania, U.S.A.
- VIII. **ARABIA. Discoveries in; and History AND RELIGION UNTIL MOHAMMED.** By Dr. EDUARD GLAZER, University of Munich, Germany.
- IX. **DEVELOPMENT OF ISLAMIC THEOLOGY, JURISPRUDENCE, AND THEORY OF THE STATE.** By Professor D. B. MACDONALD, Hartfield Theological Seminary, U.S.A.

In addition to the above the following volumes are to be included in the Series, and others may be added from time to time:—

- X. **PHENICIA. History and Government, INCLUDING COLONIES, TRADE, AND RELIGION.**
- XI. **PALESTINE AND SYRIA. Important DISCOVERIES IN RECENT YEARS.**
- XII. **ARABIC LITERATURE AND SCIENCE SINCE MOHAMMED.**
- XIII. **THE INFLUENCE OF SEMITIC ART AND MYTHOLOGY ON WESTERN NATIONS.**

LONDON:

JOHN C. NIMMO, 14 KING WILLIAM STREET, STRAND.

SECTIONAL MODELS OF STEAM AND GAS ENGINES

MANUFACTURED BY

G. CUSSONS,
THE TECHNICAL WORKS,
LOWER BROUGHTON, MANCHESTER.

Experimental Apparatus for Mechanical
Laboratories.

CUSSON'S PATENT ATWOOD MACHINE WITH
BALL BEARING HEAD.

MODELS OF MACHINE AND BUILDING DETAILS,
GEOMETRY, &c.

SEE EXHIBITS AT THE ENGLISH EDUCATION
EXHIBITION, 1900.

G. CUSSONS, TECHNICAL WORKS, MANCHESTER.

A NEW STEREOSCOPIC BINOCULAR
FIELD GLASS
OF NEW FORM and CONSTRUCTION.



(English Patents, Nos. 5639 and
7942, 1894.)

Of handy size, with large
field, brilliant definition, perfect
achromatism, and very decided
STEREOSCOPIC effect, and
which, when once adjusted, are
always ready for use.

Prices: £6 to £8.

For NAVAL MEN and DEERSTALKERS, &c. (we have made
larger sizes for NIGHT and DAY USE, admitting more light, but
of somewhat greater weight). Prices: Night, £10; Day, £11.

Illustrated Price List free.

CARL ZEISS (of JENA),

20 MARGARET STREET, REGENT STREET, LONDON, W.

JAS. SWIFT & SON,

MANUFACTURING OPTICIANS.



SOLELY APPOINTED TO THE A.M. DEPT.
WAR OFFICE, FOR THE SUPPLY
OF MICROSCOPES.

Patent form of Student's Microscope,
fitted with $\frac{2}{3}$ " and $\frac{1}{6}$ " Pan-Aplanatic
Objectives, Iris Diaphragm and Oculars,
in Case, from

£5 5s.

These Instruments we have supplied in
numbers to the following Medical Schools,
viz. St. Mary's, St. Bartholomew's, Guy's,
Middlesex, London, and St. Thomas's.
* Seven Gold Medals awarded for excel-
lence of manufacture.

Catalogue on Application.

81 TOTTENHAM COURT ROAD, W.

BACTERIOLOGY.

SEND FOR PARTICULARS OF OUR

DPH No. 2 MICROSCOPE, complete at £18 18s.

TO

C. BAKER,

244 HIGH HOLBORN, LONDON.

Also our DPH No. 1 as supplied to the London School
of Tropical Medicine for

BLOOD EXAMINATION.

IT HAS NEVER BEEN SERI-
OUSLY QUESTIONED BY:
ANY HONEST TYPEWRITER
INVENTOR, MECHANICAL:
EXPERT, OR USER, THAT THE
FUNDAMENTAL LINES UPON:::
WHICH THE **SMITH PREMIER**
IS BUILT ARE **FAR IN AD-
VANCE** OF ANY OTHER TYPE-
WRITER. THAT ALONE WOULD
NOT MERIT SUCCESS, BUT THAT
FOUNDATION TOGETHER WITH
BEST MATERIAL, BEST WORK:::
MANSHIP, AND EXPERT INSPEC-
TION OF ALL THE PARTS AS WELL
AS THE FINISHED PRODUCT,::
HAVE CAUSED THE SMITH:::
PREMIER TO WIN. THIS IS THE
EXPLANATION OF ITS PHENO-:
MENAL RECORD OF SUCCESS.

**THE SMITH PREMIER
TYPEWRITER CO.,**

14, Gracechurch St., LONDON, E.C.

Send
for
Art
Catalogue
Post
free.



THE
**AERIAL
GRAPHOSCOPE**
(BRUCE'S PATENT).

Showing Lantern Pictures in Space and Relief without a
Screen, Weird Ghost Effects and Visions, and a variety of
Entirely Original Experiments on Persistence of Vision.

Exhibited at the Soirées of the Royal Society, Royal Insti-
tution, Society of Arts, London Institution, &c., &c.

The Inventor, **MR. ERIC STUART BRUCE**, M.A.
Oxon., F.R. Met. Society, can accept Engagements for his
Elaborately Illustrated Lecture on this complete Novelty, also
for shorter Demonstrations at Soirées, Photographic Exhi-
bitions, and other Entertainments.

APPLY TO

E. S. BRUCE, Esq.,

19 CAMPDEN HOUSE ROAD, KENSINGTON,
LONDON, W.



COSSOR,
87
FARRINGTON RD.,
E.C.

Original Maker of "**X**" RAY TUBES in England.

FOCUS TUBES giving finest possible definition. **IMPROVED TUBE
HOLDERS**, with arrangement for securing wires to avoid perforation of tube.
All kinds of "**X**" Ray Apparatus, Mercury Pumps, Screens, Spark
Gaps, &c. *Applications for Price Lists invited.*

NOTICE.—The attention of the readers of this Journal is called to the

NATURE RE-ISSUE

OF THE

INTERNATIONAL SCIENTIFIC SERIES.

EIGHTY-SIX VOLUMES.

A COMPLETE LIBRARY OF SCIENCE AT
A GREATLY REDUCED PRICE.

PUBLISHERS' PRICE	...	...	...	...	£21	10	0
BY INSTALMENT (TO-DAY)	...	...	...	...	£14	14	0
FOR CASH	...	...	...	...	£13	10	0

The "International Scientific Series" has a world-wide reputation, and is to be found in every well-equipped Library throughout the English-speaking world. No more generous or acceptable present could be made to any Public Library or individual than this magnificent Encyclopædia of Scientific Research.

Most of the works are illustrated, and many with beautiful coloured plates. The Series has been contributed to by men of science of the highest eminence, such as Tyndall, Herbert Spencer, Walter Bagehot, Alexander Bain, Stanley Jevons, Huxley, Sir John Lubbock, G. J. Romanes, Balfour Stewart, Sir Norman Lockyer, Draper, Bonney, Sir Hubert Parry, Sir E. Maunde Thompson. This list only professes to convey a slight idea of the attention that has been given to the whole Series by the selection of only the best writers to deal with the various subjects considered.

This special offer is open only for a short time, and intending purchasers will do well therefore to send their orders without delay.

For the benefit of those who do not feel disposed to buy the entire Series, it will be possible to secure half the Series, making 43 volumes, for £7 cash, or £7 7s. on the instalment system. The whole Series or half, as the case may be, will be sent on receipt of the first payment of One Guinea—the rest to be paid at the rate of £1 1s. per month.

NOTE:—OFFER OPEN ONLY FOR A SHORT TIME.

ORDER AT ONCE.

A Set of the Volumes may be seen at the Office of NATURE, ST. MARTIN'S STREET, W.C.

A Pamphlet, giving titles, &c., of the Works in the Series, Specimen Pages, with Illustrations, of some of the Volumes, also Order Form, will be sent Post free on application to

C. WORSFOLD, NATURE OFFICE, ST. MARTIN'S STREET, LONDON, W.C.

ORDER FORM.

Date.....1900.

All cheques should be crossed and made payable to C. WORSFOLD, "NATURE" Office, St. Martin's Street, W.C.

I enclose One Guinea as first payment for "NATURE'S Re-issue of the International Scientific Series," and I agree to pay to you, or your representative, the balance at the rate of One Guinea per month; my next payment to be on delivery of the volumes, and my remaining payments on the corresponding day of each month following.

Until such payments are complete, I engage that the Works, not being my property, shall not be disposed of by sale or otherwise.

I further agree that if it be found impossible for any reason to deliver the books, the return of the sum of One Guinea to me shall cancel this agreement.

Name.....

Address.....

Residents abroad are kindly requested to remit in full, or to instruct their representatives in England to make the monthly payments, in order to avoid the expense and delay in forwarding cash from abroad.

THE JOURNAL OF ANATOMY AND PHYSIOLOGY, NORMAL AND PATHOLOGICAL, HUMAN AND COMPARATIVE.

CONDUCTED BY
PROFS. TURNER, CUNNINGHAM, HUNTINGTON,
MACALISTER, and M'KENDRICK.

Vol. XXXIV.—New Series, Vol. XIV. Part II.—JANUARY 1900.

Now Ready. Price 6s.

With Plates and Figures in Text.

CONTENTS OF PART II.—JANUARY 1900.

- 1.—Richard J. A. Berry, M.D., and John Crawford, M.B. The Stomach and Pylorus. (Plates XXIII.—XXVI.)
 - 2.—Professor Cleland. Duplicity of Cervix Uteri in Trichesus and Otaria. (Plate XXVII.)
 - 3.—James F. Gemmill, M.B. Vitality of Ova and Spermatozoa of Certain Animals.
 - 4.—A. Francis Dixon, M.B. Form of Empty Bladder, and its Connections with Peritoneum; Form of the Prostate. (Plates XXVIII.—XXX.)
 - 5.—W. B. Drummond, M.B. Structure and Functions of Hæmolymp Glands. (Plates XXXI.—XXXIII.)
 - 6.—E. Wace Carlier, M.D. Presence of Ciliated Cells in Human Adult Kidney.
 - 7.—J. Symington, M.D. Thymus Gland in Koala (*Phascogale*). (Plates XXXIV.—XXXV.)
 - 8.—A. M. Paterson, M.D., and F. T. Lovegrove, M.R.C.S. Symmetrical Perforations of Parietal Bones. (Plates XXXVI.—XXXIX.)
 - 9.—J. Charles, M.D. Causes of Entrance of Oxygen into the Blood in the Lungs.
 - 10.—Robert Dwyer Joyce, F.R.C.S.I. Topography of Facial Nerve in its Relation to Mastoid Operations.
 - 11.—David Waterston, M.B. Craniometric Observations in Post-Mortem Room.
 - 12.—F. G. Parsons. Ninth Report of Committee of Collective Investigation of Anatomical Society of Great Britain and Ireland.
 - 13.—Sir Wm. Turner. Australian Skull with Three Supernumerary Upper Molar Teeth.
 - 14.—Archæologia Anatomica.
 - 15.—Notices of New Books.
 - 16.—Proceedings of the Anatomical Society of Great Britain and Ireland.
- London: CHARLES GRIFFIN & CO., Ltd., Exeter Street, Strand.

MR. EDWARD ARNOLD'S LIST.

A TEXT-BOOK OF PHYSICAL CHEMISTRY. By Dr. R. A. LEHFELDT, Professor of Physics at the East London Technical College. Crown 8vo, Cloth, 7s. 6d.

MAGNETISM AND ELECTRICITY. By J. PALEY YORKE, of the Northern Polytechnic Institute. Crown 8vo, 3s. 6d.

ELEMENTARY NATURAL PHILOSOPHY. By ALFRED EARL, M.A., Assistant Master at Tonbridge School. With numerous Illustrations and Diagrams. Cloth, 4s. 6d.

A MANUAL OF PHYSIOLOGY. By LEONARD HILL, M.B., Lecturer in Physiology at the London Hospital Medical College. With numerous Illustrations and Diagrams. 6s.

Journal of Education.—"Mr. Hill is one of the most brilliant of our younger physiologists, and has won a deservedly high place in the scientific world by his masterly work upon the circulatory system. We have found Mr. Hill's Manual the freshest and most fascinating book upon the subject since Huxley's classic Lessons; and we regard it as the best introduction to Modern Physiology in the English language."

LECTURES ON THEORETICAL AND PHYSICAL CHEMISTRY. Part I. CHEMICAL DYNAMICS. By Dr. J. H. VAN T'HOFF, Professor at the University of Berlin. Translated by Dr. R. A. LEHFELDT, Professor at the East London Technical College. One vol. Demy 8vo, 12s. net.

PHYSICAL CHEMISTRY FOR BEGINNERS. By Dr. VAN DEVENTER. Translated by Dr. R. A. LEHFELDT. Crown 8vo, 2s. 6d.

CHEMISTRY FOR AGRICULTURAL STUDENTS. By T. S. DYMOND, of the County Technical Laboratory, Chelmsford. Cloth, 2s. 6d.

ELECTRICAL TRACTION. By Ernest WILSON, Wh.Sc., M.I.E.E., Professor of Electrical Engineering in the Siemens Laboratory, King's College, London. Crown 8vo, Cloth, 5s.

STEAM BOILERS. By George Halliday. With numerous Diagrams and Illustrations. 400 pages. Crown 8vo, 5s.

THE CALCULUS FOR ENGINEERS. By Prof. JOHN PERRY, F.R.S. Third Edition. Crown 8vo, Cloth, 7s. 6d.

London: EDWARD ARNOLD, 37 Bedford Street, Strand.

Medals and Highest Awards at all Great Exhibitions.

ROSS'

ESTD. 1830.



NEW SERIES SCIENCE LANTERNS

FOR SCHOOLS,
COLLEGES, & PRIVATE
EXHIBITIONS.

PHOTOGRAPHIC LENSES
AND CAMERAS.

MICROSCOPES,
TELESCOPES, FIELD
GLASSES, &c., &c.

ROSS' PATENT NEW MODEL

PRISMATIC BINOCULAR GLASS.



"The power and field of a Telescope in the compass of an Opera Glass."

Combining Extreme Portability with High Power, Perfect Mechanical Construction, and Exquisite Definition.	Magnification.	Binocular.
	6 times ...	28 0 0
	8 " ...	8 0 0
	10 " ...	10 0 0
	12 " ...	10 0 0

ROSS, Ltd., Manufacturing Opticians,

111 NEW BOND STREET, LONDON, W.,
And 31 COCKSPUR STREET, CHARING CROSS, S.W.

IMPROVED D'ARSONVAL GALVANOMETERS.

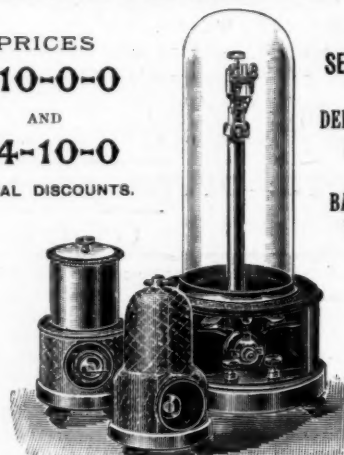
PRICES

£10-0-0

AND

£4-10-0

LIBERAL DISCOUNTS.

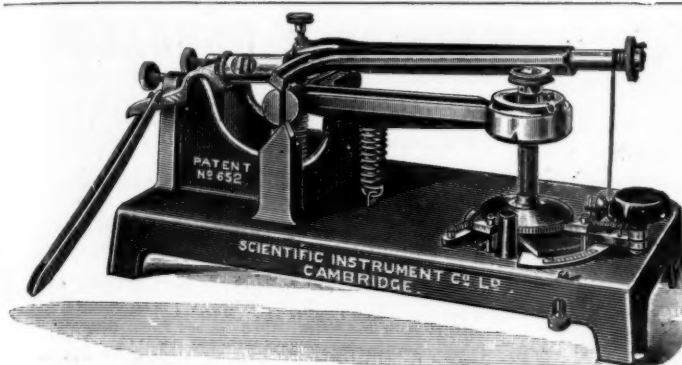


Most
SENSITIVE
for
DEFLECTIVE,
ZERO,
or
BALLISTIC
WORK.

Write for Price List and Particulars of Potentiometers, Galvanometers, Electrical Thermometers, Experimental Direct and Alternating Current Sets, &c., to

CROMPTON & CO., LD.,

Laboratory { "THRIPLANDS," } LONDON, W.
KENSINGTON COURT,



THE CAMBRIDGE
SCIENTIFIC INSTRUMENT CO.,
Ltd., CAMBRIDGE.

NEW ROCKING MICROTOME.
1900 PATTERN. [PATENTED.]

This Instrument possesses the following great improvements over the old type of instruments:—
(1) Increased rigidity. (2) The impossibility of cutting thin and thick sections. (3) The impossibility of tearing sections on the upward movement of the object. (4) A graduated arc for showing the thickness of the sections. (5) Catch for holding the object above the edge of the razor. (6) Improved method of fixing the cord. (7) A new object holder.

Price (including object holder), £5 0 0
Write for Pamphlet descriptive of the above Instrument.

Address all communications to:—
INSTRUMENT COMPANY, CAMBRIDGE.

For Photography, Unsurpassed for fine definition.

COOKE LENSES

TAYLOR, TAYLOR, & HOBSON,
Stoughton Street Works, Leicester;
and 18 Berners Street, London, W.

PHŒNIX FIRE OFFICE,
19 LOMBARD ST., E.C., and 57 CHANCING CROSS, S.W.
ESTABLISHED 1782.

MODERATE RATES. ABSOLUTE SECURITY.
ELECTRIC LIGHTING RULES SUPPLIED.
LIBERAL LOSS SETTLEMENTS.
PROMPT PAYMENT OF CLAIMS.
FRANCIS B. MACDONALD, SECRETARY.
LOSSES PAID OVER £22,000,000.

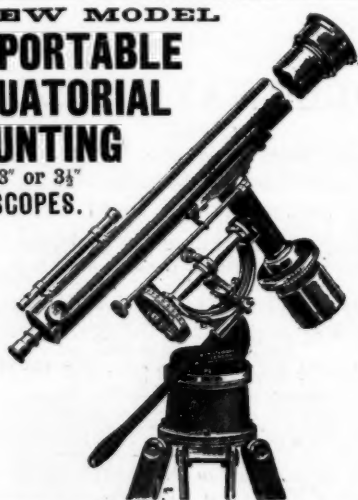
NOTICE OF REMOVAL.
W. G. PYE & CO.,
SCIENTIFIC INSTRUMENT MAKERS,
"GRANTA" WORKS,
MILL LANE, CAMBRIDGE

(Late 30 ST. ANDREW'S STREET, CAMBRIDGE),
Beg to inform their numerous Clients that owing to a steady increase in their business they have found it necessary to remove to larger premises. With an up-to-date Plant and a larger Staff they hope to be able to despatch Orders with even more promptitude than they have hitherto done.

CHEAP AND EFFICIENT APPARATUS FOR
SCIENCE SCHOOLS A SPECIALITY.
CATALOGUES ON APPLICATION AND CORRESPONDENCE
INVITED.

NEW MODEL
PORTABLE
EQUATORIAL
MOUNTING

For 3" or 3½"
TELESCOPES.



Latitude Adjustment, Clamp for Declination Axis, Quick and Slow Motion, in Right Ascension.

EQUATORIAL MOUNTING with Divided Circles and Stand fitted with short Iron Column, Levelling Screws, and Metal Stretcher, £15 15s.; or, complete with 3" Telescope, £25.

ILLUSTRATED CATALOGUE GRATIS.

J. H. STEWARD,
OPTICIAN,
406 STRAND, 457 WEST STRAND,
7 GRACECHURCH STREET, LONDON.

C. E. MÜLLER & CO.,
SCIENTIFIC GLASS BLOWERS,
AND MANUFACTURERS OF
CHEMICAL & PHYSICAL APPARATUS,
X-Ray Tubes, Argon and Helium Spectrum Tubes,
Special Apparatus for Research, Chemical
Thermometers, &c., &c.



NEW
GEISSLER
TUBES.

The Flowers appearing in their Natural Colours under the Kathode Rays.

PRICE £1 1 0

AN ASSORTMENT KEPT IN STOCK.

PRICE LISTS OF CHEMICAL
APPARATUS ON APPLICATION.

148 HIGH HOLBORN,
LONDON, W.C.

THE GEOGRAPHICAL JOURNAL.

Price 2s. CONTENTS.—JANUARY.

On Desert Sand-Dunes bordering the Nile Delta. By Vaughan Cornish.
 The "Yermak" Ice-Breaker. By Vice-Admiral Makaroff, of the Russian Imperial Navy.
 On the Configuration of the Earth's Surface, with special reference to the British Islands. By the Right Hon. Sir John Lubbock, Bart., M.P.
 A Record of Exploration in North-East Africa.
 Distribution of Agricultural Products outside the Tropics. By A. J. Herbertson.
 Lieut. Kozloff's Expedition to Central Asia.
 The Monthly Record.
 Obituary: Sir Rawson William Rawson, K.C.M.G., C.B.
 Correspondence: Longitude of Nkata Bay, Lake Nyasa. By Captain C. F. Close.—The Mansarowar and Rakastal Lakes. By Lieut. G. Kendall-Channer.
 Meetings of the Royal Geographical Society, Session 1899-1900.
 Geographical Literature of the Month.
 New Maps. Numerous Maps and Illustrations.
 EDWARD STANFORD. 26-27 Cockspur Street, Charing Cross.

MINERALS, ROCKS & FOSSILS.

COLLECTIONS FOR STUDENTS.

Carefully labelled and arranged in Boxes with Card Trays.
 50 Minerals, 12/6; 100 do., 21/-; 200 do., 42/-.
 Rocks and Fossils at similar prices.
 300 Minerals in Cabinet, £4 4s.; 400 do., £5 12s. 6d.
Catalogues Post Free.

THOMAS D. RUSSELL,

78 NEWGATE STREET, LONDON, E.C.

PHYSIOGRAPHY and GEOLOGY.

COLLECTIONS & MICROSCOPIC SLIDES,

As advised by Science and Art Directory, arranged by

JAMES R. GREGORY & CO.,

Mineralogists, &c.,

To Science and Art Department, British, Indian and Colonial Museums, &c.

NOVELTIES and RARE GEMS and PRECIOUS STONES.

*Mineral Specimens for Museums, and Collectors, and all purposes.
 Rock Specimens and Microscopic Sections of Rocks and Minerals cut to order.*

NEW AND VALUABLE MINERAL SPECIMENS CONSTANTLY ARRIVING.

Stores & Offices: 1 Kelso Place, KENSINGTON, W.

NEW CATALOGUES AND LISTS FREE.

ESTABLISHED 1861.

BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

INVESTED FUNDS

£10,000,000.

The BIRKBECK ALMANACK, with full particulars, post free.

FRANCIS RAVENSCROFT, Manager.

THE MOST NUTRITIOUS.

EPPS'S

GRATEFUL—COMFORTING.

C O C O A

BREAKFAST—SUPPER.

NOTICE.—Advertisements and business letters for NATURE should be addressed to the Publishers; Editorial communications to the Editor. The telegraphic address of NATURE is "PHUSIS," LONDON.

SUBSCRIPTIONS TO "NATURE."

	£	s.	d.
Yearly	1	8	0
Half-yearly	0	14	6
Quarterly	0	7	6
TO ALL PLACES ABROAD:—			
Yearly	1	10	6
Half-yearly	0	15	6
Quarterly	0	8	0

Cheques and Money Orders payable to MACMILLAN & CO., Limited.

OFFICE: ST. MARTIN'S STREET, LONDON W.C.

WATKINS & DONCASTER,NATURALISTS,
AND MANUFACTURERS OF**CABINETS AND APPARATUS**

FOR ENTOMOLOGY, BIRDS' EGGS, AND ALL BRANCHES OF NATURAL HISTORY.

SPECIAL SHOW-ROOM FOR CABINETS.

Call or send for detailed Catalogue (86 pp.), Post free on application.

N.B.—For Excellence and Superiority of Cabinets and Apparatus, references are permitted to distinguished patrons, Museums, Colleges, &c.

A LARGE STOCK OF INSECTS AND BIRDS' EGGS.

Birds, Mammals, &c., Preserved and Mounted by First-class Workmen with true natural surroundings. All Books and Publications on Natural History supplied.

36 STRAND, LONDON, W.C.

(Five Doors from Charing Cross.)

LIVING SPECIMENS FOR THE MICROSCOPE.

Volvox, Spirogyra, Desmids, Diatoms, Amœba, Arcella, Actinosphærium, Vorticella, Stentor, Hydra, Floscularia, Stephanoceros, Melicerta, and many other Specimens of Pond Life. Price 1s. per Tube, Post Free. Helix, Planorbis, Astacus, Amphioxus, Rana, Anodon, &c., for Dissection purposes.

THOMAS BOLTON,

25 BALSALL HEATH ROAD, BIRMINGHAM.

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM.

THE LABORATORY, PLYMOUTH.

The following animals can always be supplied, either living or preserved by the best methods:—

Sycon; Clava, Obelia, Sertularia; Actinia, Tealia, Caryophyllia, Alcyonium; Hormiphora (preserved); Leptoplana; Lineus, Amphiporus; Nereis, Aphrodite, Arenicola, Lanice, Terebella; Lepas, Balanus, Gammarus, Ligia, Mysid, Nebalia, Carcinus; Patella, Buccinum, Eledone, Pecten, Bugula, Crisia, Pedicellina, Holothuria, Asterias, Echinus; Ascidia, Salpa (preserved), Scyllium, Raja, &c., &c.

For prices and more detailed lists apply to Biological Laboratory, Plymouth.

THE DIRECTOR.

HOLLOWAY'S PILLS

CURE

Biliousness, Sick Headache, Indigestion, and all Internal Complaints.

CAN BE TAKEN BY THE MOST DELICATE.

Holloway's Pills and Ointment may be obtained of all Medicine Vendors.

THE IRISH NATURALIST.

A Monthly Magazine of Irish Zoology, Botany, and Geology. Price 6d.

Edited by GEO. H. CA PENTER, B.Sc., and R. LLOYD PRAEGER, B.A.

Annual Subscription, 5s. Post Free to any Address.

Dublin: EASON & SON, LTD., 40 Lower Sackville Street (to which Address Subscriptions should be sent).

London: SIMPKIN, MARSHALL, HAMILTON, KENT, & CO., Ltd

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
*Three Lines in Column	0	2	6
Per Line after	0	0	9
One Eighth Page, or Quarter Column	0	18	6
Quarter Page, or Half a Column	1	15	0
Half a Page, or a Column	3	5	0
Whole Page	6	6	0

* The first line being in heavy type is charged for as Two Lines.

CO-OPERATIVE WORLD TRAVEL

Organised by HENRY S. LUNN, M.D., F.R.G.S.,
W. HOLDSWORTH LUNN & CONNOP F.S. PEROWNE

A Cruise to the EASTERN MEDITERRANEAN.

(Return ticket to MARSEILLES included.)

MARSEILLES, SYRACUSE, PIRÆUS (for Athens),
CONSTANTINOPLE, JAFFA (for Jerusalem), ALEXANDRIA,
MALTA, NAPLES, MARSEILLES.

A THIRTY-FIVE DAYS' CRUISE FOR £36 15s. AND UPWARDS.

A Cruise to GREECE, CONSTANTINOPLE, PALESTINE, and EGYPT.

(Return Ticket to MARSEILLES included.)

A FORTY-TWO DAYS' CRUISE FOR £44 2s. AND UPWARDS.

S.Y. ARGONAUT. Tonnage, 3254; h.-p., 4000.

Full particulars from the Secretary, 5 Endsleigh Gardens,
Euston, London, N.W.

ORIENT COMPANY'S PLEASURE CRUISES

By their Steamship

LUSITANIA (3912 tons register),

For SOUTH OF SPAIN, SICILY, PALESTINE, and EGYPT, embarking
passengers at London, 15th February, and at Villefranche (Nice), 1st
March.

The following places will be visited:—CADIZ, TANGIER, MALAGA,
PALMA, VILLEFRANCHE, TAORMINA, SANTORIN, KY-
RENIA, BEYROUT, HAIFA, JAFFA, PORT SAID, ALEXANDRIA
(for Cairo), NAPLES, ALGIERS, and GIBRALTAR. The Steamer will
arrive back in London on 13th April.

String Band, Electric Light, High-class Cuisine.

Managers { F. GREEN and CO. Head Offices: }
ANDERSON, ANDERSON, and CO. Fenchurch Avenue.

For passage apply to the latter Firm, at 5 Fenchurch Avenue, London
E.C.; or to the West End Branch Office, 16 Cockspur Street, S.W.

ALBERT EDWARD JAMRACH

(Late CHARLES JAMRACH),

NATURALIST,

180 ST. GEORGE STREET EAST.

Implements of Savage Warfare, Idols, Sacred Masks, Peruvian Pottery,
Netsukis China, Lacquers, Gongs, Shells, and other Curios.

THE SCIENTIFIC ROLL AND MAGAZINE OF SYSTEMATIZED NOTES.

THIS WORK IS A VALUABLE
GUIDE, BIBLIOGRAPHY, AND INDEX TO SCIENCE.

In preparation.

BACTERIA (Botanical Section).

Although these are the simplest of plants, there is probably no group of
organisms which exceeds them in interest or importance. Their operations
affect the *welfare of every member of the community*, as also of the whole
organic world. A full knowledge of them is essential in all questions
bearing upon public and private health, agriculture, the microbial diseases
of animals and of plants; and it is important in many industries, such as
those dealing with milk, butter, hay, flax, tobacco, and others.

The group will be dealt with in three octavo volumes of about 500 pp.
each. The subscription price will be 10s. for each volume, payable on
delivery of the first number of the volume; or arrangements may be made
to supply only the portions relating to a particular species, genus, or topic,
at a proportionately reduced rate. The first volume will be commenced
next summer, and if sufficient subscribers support the work, the three
volumes will be completed in three years. As all the matter will be
systematized, the series will be equivalent to a good bacteriological library,
with the advantage that the information on any particular point will be
comprised within a comparatively few pages, and not scattered over
thousands of pages in a host of journals and books.

The names and addresses of subscribers, and applications for prospectus
may be sent to the undersigned.

The undersigned will be glad to hear from PRINTERS willing to give
estimates for printing, and from PUBLISHERS willing to consider terms for
publishing the above-mentioned work.

A. RAMSAY,
4 Cowper Road, Acton, London, W.

TO SCIENCE LECTURERS. HUGHES' MOTO-PHOTOSCOPE FOR LIVING PICTURES.

THE MOST PERFECT.

No SHUTTER, therefore no Flickering. Superb Mechanism.

The Moto-Photo Camera for taking the Pictures. Illustrated Lists, &c.

See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN,
&c. Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great
success. New Oxyhydrogen Microscope. Science Lanterns for Class
Demonstration. Magnificent Results. Docwra Triple, Prize Medal.
Highest Award. Supplied to the Royal Polytechnic Institution, Dr. H. GRAT-
TAN GUINNESS, Madame ADELINA PATTI, &c. Patent Pamphengos
Science Lanterns. The Universal Lantern 4-inch Condensers, 4-wick Lamp,
Portrait Combination front Lenses, 12s. 6d., Marvellous value. Science
Lecture Sets. Novelties. The Lantern Kaleidoscope. Cheapest Lantern
Outfits in the World. Grandly Illustrated Catalogue, over 120 choice En-
gravings, 6d.; Postage, 3d. List of 500 Lecture Sets, Science Subjects,
Views, &c., 6d.; Postage 2d. Pamphlets Free. W. C. HUGHES,
SPECIALIST, Brewster House, 8s Mortimer Road, Kingsland, N.

BORD'S PIANOS

25 per cent. Discount for Cash, or 14/6 per month (second-hand, 10/6 per
month) on the Three Years' System. Lists free of

C. STILES & CO., 40 & 42 Southampton Row, London, W.C.

PIANOS EXCHANGED.

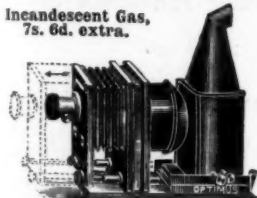
BECHSTEIN PIANOS

These magnificent Pianos for Hire on the Three Years' System at
advantageous prices and terms. Lists and particulars free of

CHAS. STILES & CO., 40 & 42 Southampton Row,
LONDON, W.C.

"OPTIMUS" CANTILEVER PHOTOGRAPHIC ENLARGER.

Incandescent Gas,
7s. 6d. extra.



This already popular model
is finished in a very superior
and practical style. The lamp
gives a brilliant and even light.
The optical system is through-
out the best. The Lens will
be found to give a very flat
field and good marginal defini-
tion.

* SUITED FOR POCKET
CAMERA NEGATIVES.

Diam. of Condenser	... 4in.	5in.	6in.	8in.	10in.
Price, no Front Lens	... 62/-	70/-	80/-	110/-	200/-
Extra for Front Lens	... 27/-	27/-	37/-	63/-	63/-
Covering Plates	... 3 1/2 x 3 1/2	4 1/2 x 3 1/2	6 1/2 x 4 1/2	8 1/2 x 5 1/2	10 1/2 x 7 1/2

Catalogue POST FREE.

"OPTIMUS" MAGIC LANTERNS FOR DRAWING ROOM AND LECTURE HALL.

Each Lantern is efficient for Exhibitions.
The Lens gives crisp definition, being a
superior Achromatic Photographic Combination,
with Rack and Pinion, compound Con-
denser of 4-in. diameter. Each has 3-wick
Refugent Lamp, and is Complete in box.
(4-wick Lamp, 2s. extra.)



Mahogany outside Body, Panelled Door,
Brass Stages, and 3-draw Sliding Tubes, so
that lenses of long focus may be used when
projecting upon a screen at a great distance, £5 5s.

Mahogany outside Body, lined with metal, making a
thoroughly practical instrument, and really good value ... £2 12 0

Russian Iron Body, Brass Sliding Tubes (Educational)... 3 3 0

Do. do. (College) ... 2 8 0

PERKEN, SON & RAYMENT, 99 HATTON GARDEN, LONDON.
HOLBORN CIRCUS, E.C.

MACMILLAN & CO.'S NEW BOOKS.

NEW WORK BY GOLDWIN SMITH.

THE UNITED KINGDOM: A POLITICAL HISTORY.

By GOLDWIN SMITH, D.C.L.,

Author of "The United States," &c. In Two Vols. 8vo, 15s. net.

DAILY TELEGRAPH—"Mr. Goldwin Smith has written a history of British politics for the ordinary reader, which fulfils that particular purpose not only well, but incomparably better than anything that existed. . . . Nothing else brings us quite so closely in touch as these pages do with the pure politics of English history from first to last, nor is there any other single book in which our intercourse with the entire series of important political personages is so quick and intimate."

THE NEW DEMOCRACY: A Political Study. By W. JETHRO BROWN, M.A.,

LL.D., &c. Demy 8vo, 7s. 6d.

SCOTSMAN—"A thoughtful political study. . . . It is so well reasoned and so closely studied upon modern conditions as to be likely to prove both interesting and valuable to every one interested in the progress of democratic institutions."

VOLUME II. NOW READY.

THE SCIENTIFIC MEMOIRS OF THOMAS HENRY HUXLEY.

Edited by Prof. Sir MICHAEL FOSTER, K.C.B., and Prof. E. RAY LANKESTER, M.A., LL.D. In Four Volumes. Vol. I., 25s. net. Vol. II. With PORTRAIT. Super Royal 8vo, 30s. net.

* * Sold in Sets only.

NEW BOOK BY CHARLES W. WOOD.

IN THE VALLEY OF THE RHONE. By CHARLES W. WOOD, F.R.G.S., Author

of "Letters from Majorca," &c. With 88 Illustrations. 8vo, 10s. net.

MANCHESTER COURIER—"To those who cannot hope to spread their wings so far, the charm and grace of Mr. Wood's tale of travel are productive of much pleasure. . . . Written in a style now vivid and sparkling, now chatty and confidential."

BY FIELD-MARSHAL LORD ROBERTS.

THIRTIETH EDITION. Extra Crown 8vo, 10s. net.

FORTY-ONE YEARS IN INDIA. FROM SUBALTERN TO COMMANDER-IN-CHIEF.

By Field-Marshal the Right Hon. LORD ROBERTS of Kandahar, V.C., K.P., G.C.B. Containing Forty-four Illustrations and Plans.

THE WAR IN SOUTH AFRICA.

Third Edition, with a new Prefatory Chapter, dealing with the events which have induced the present Crisis.

IMPRESSIONS OF SOUTH AFRICA. By the Right Hon. JAMES BRYCE, M.P.

With Three Maps, and with the Text of the Transvaal Conventions of 1881 and 1884. Crown 8vo, 6s.

NEW AND CHEAPER EDITION NOW READY.

SOUTH AFRICA OF TO-DAY. By Captain FRANCIS YOUNGHUSBAND, C.I.E.,

Indian Staff Corps, late Special Correspondent of the *Times* in South Africa. With Illustrations. Crown 8vo, 6s.

MANUALS OF MEDICINE AND SURGERY.

A MANUAL OF SURGERY. By CHARLES STONHAM, F.R.C.S. Eng., Senior

Surgeon to the Westminster Hospital; Lecturer on Surgery and on Clinical Surgery, and Teacher of Operative Surgery, Westminster Hospital; Surgeon to the Poplar Hospital for Accidents; late Member of the Board of Examiners in Anatomy under the Conjoint Scheme for England, &c. In Three Vols. Extra Crown 8vo.

Vol. I. GENERAL SURGERY. 7s. 6d. net.

Vol. II. INJURIES. 7s. 6d. net.

Vol. III. REGIONAL SURGERY. 10s. 6d. net.

INTRODUCTION TO PHYSICAL CHEMISTRY. By JAMES WALKER, D.Sc.,

Ph.D., Professor of Chemistry in University College, Dundee. 8vo, 10s. net.

SCHOOL WORLD—"Professor Walker already has a deservedly high reputation as a clear and stimulating writer on chemical theory, and in his most recent book there is abundant evidence that his right hand has not forgot his cunning."

EXPERIMENTAL SCIENCE (PHYSIOGRAPHY, SECTION I.).—An Ele-

mentary Course of Physics and Chemistry adapted to the Syllabus of the Science and Art Department. By R. A. GREGORY, Oxford University Extension Lecturer, Professor of Astronomy, Queen's College, London, and A. T. SIMMONS, B.Sc. (Lond.), Associate of the Royal College of Science, London. Globe 8vo. 2s. 6d.

EDUCATIONAL NEWS—"We have much pleasure in calling the attention of students to this excellent manual."

MACMILLAN AND CO., LIMITED, LONDON.

MACMILLAN'S LIBRARY OF ENGLISH CLASSICS.

Under the above title Messrs. MACMILLAN & COMPANY, Limited, propose to issue reprints of various

STANDARD WORKS OF ENGLISH LITERATURE

for which they believe there is a demand, printed from large type in Demy 8vo volumes, and sold in cloth at the uniform price of 3s. 6d. net per volume. The books will contain neither New Introductions nor New Notes, the idea being to present typographically perfect reprints of the best existing texts. In deciding the question as to which is the best edition to reproduce, the publishers have been fortunate in obtaining the assistance of Mr. A. W. POLLARD, Hon. Sec. of the Bibliographical Society, and beyond a bibliographical note to each book from his pen, the Series will contain no fresh editorial matter.

The aim of the publishers will be to give complete and accurate texts, so that lovers of English Literature may have the opportunity of possessing the works of their favourite writers in a form at once handsome and inexpensive, and printed in the Demy 8vo size, which has always been regarded as most suitable for the study of a private gentleman, and for the shelves of a Public Library.

The publishers hope that if the Series meets with the support they anticipate for it, it may eventually run to a considerable number of volumes, but they do not pledge themselves to bring out more than the twenty-five volumes mentioned below, all of which, however, will appear during the year 1900.

The following is a list of the first twenty-five volumes of the Series:—

Bacon's Essays; Colours of Good and Evil; and Advancement of Learning	1 vol.	[Ready.]	Fielding's Tom Jones	...	...	2 vols.
Sheridan's Plays	...	1 vol.	[Ready.]	White's Natural History of Selborne	...	1 vol.
Travels of Sir John Mandeville, with Illus- trative Narratives from Hakluyt	...	1 vol.	Boswell's Life of Johnson	...	...	3 vols.
Malory's Morte Darthur	...	2 vols.	De Quincey's Confessions of an English Opium Eater; Murder as a Fine Art; The English Mail Coach, and other Essays	...	1 vol.	
Don Quixote translated by Shelton	...	3 vols.	Lockhart's Life of Scott	...	...	5 vols.
Walton's Lives and Complete Angler	...	1 vol.	Carlyle's French Revolution	...	...	2 vols.
The Works of Laurence Sterne	...	2 vols.				

MACMILLAN & CO., LIMITED, LONDON.

The.. **'N. & G.' Cameras**

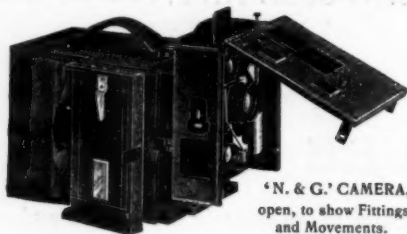
In all sizes up to 7 x 5 in.
For Plates, Cut Films, or Film
in Spools.

For Hand and Tripod.

A Series of High-Class Instruments for *Serious Work*,
embodying every New Advance in Photography.

Prices from £13 to £50.

Have been in Constant Use for Eight Years in all parts of the World.



'N. & G.' CAMERA,
open, to show Fittings
and Movements.

TRIPOD CAMERAS, SURVEYING CAMERAS, and very Small and
Light POCKET CAMERAS for Travellers and Field Naturalists.

Speciality: COMPLETE OUTFITS for Scientific Expedi-
tions and Special Research.

Catalogues and Estimates Lenses, Kinematographs, Lanterns, and all
free on application. Photographic Accessories and Materials.

Newman & Guardia, Ltd.

90 & 92 Shaftesbury Avenue, London, W.

JAS. J. HICKS, 8, 9 & 10 HATTON GARDEN, LONDON, SCIENTIFIC INSTRUMENT MAKER

TO THE
WAR OFFICE, INDIA OFFICE, ADMIRALTY, &c.

THE ACTUAL MANUFACTURER

OF
BAROMETERS AND THERMOMETERS OF ALL KINDS.
ALSO OF THE
FAMOUS "WATKIN" MOUNTAIN ANEROID BAROMETER
WHICH CAN BE
THROWN IN OR OUT OF ACTION AS REQUIRED.

ALSO OF
AIR METERS ANEMOMETERS
BOILING POINT APPARATUS
CATHETOMETERS CLINOMETERS GAUGES
MICROSCOPES PLANE TABLES
RANGE FINDERS SEXTANTS
SPHYGMOMETERS THEODOLITES
&c., &c., &c.

CATALOGUES POST FREE. STATE WHICH REQUIRED.

Any kind of Scientific Instrument
made to Order.

PROMPT ATTENTION TO ALL ORDERS AND
INQUIRIES.

OPPOSITE THE BRITISH MUSEUM.

THACKERAY HOTEL

(TEMPERANCE).

GREAT RUSSELL STREET, LONDON.

THIS newly-erected and commodious Hotel will, it is believed, meet the requirements of those who desire all the conveniences and advantages of the larger modern licensed hotels at moderate charges. Passenger Lift. Electric Light in all Rooms. Bath-rooms on every Floor. Spacious Dining, Drawing, Writing, Reading, and Smoking Rooms. All Floors Fireproof. Perfect Sanitation. Night Porter. Telephone. Bedrooms from 2s. 6d. to 4s. 6d. per night. Full Tariff and Testimonials on application.

Telegraphic Address: "THACKERAY, LONDON."

Proprietor—J. TRUSLOVE.

Also, amalgamated with, and under the same management,

ESMOND HOTEL

(TEMPERANCE).

MONTAGUE STREET, RUSSELL SQUARE.

THIS Hotel, which has been carried on so successfully for the last 13 years, adjoins the British Museum, and is exceptionally quiet. Bedrooms from 2s. to 3s. 6d. per night. Full Tariff and Testimonials on application.

Telegraphic Address: "TRUSLOVE, LONDON."

Proprietor—J. TRUSLOVE.

THE SCIENTIFIC MAN'S, NATURALIST'S, AND TRAVELLER'S CAMERA IS THE

STEREOSCOPIC COMPANY'S (IMPROVED TWIN-LENS)

CARLTON.

1. It gives power to focus for any distance.
2. It has a FULL-size finder.
3. It shows the exact size of the image.
4. It has Lenses working at f/5.6.
5. It has Iris Diaphragm to working lens.
6. It has a Safety Shutter.
7. It has a pneumatic control for all speeds.
8. It gives Time and Instantaneous exposures.
9. It holds twelve Plates or Films.
10. It registers the number of Plates taken.
11. It can be used as a Stand or Hand Camera.
12. Exposed Plates can be developed without disturbing those unused.
13. It is small, light, and perfectly constructed.
14. It will stand extremes of climate.
15. It is an expert's camera.
16. Workmanship and advantages considered, it is the cheapest Twin-Lens Camera in the market.

Prices of the Twin-Lens "CARLTON."

With Euryscope Lenses, and all other advantages as detailed.

To carry Twelve Plates or Twelve Films.

4½ by 3½	£12 12s.
5 by 4	£15 15s.
6½ by 4½	£21.

Net.

FREE LESSONS TO PURCHASERS.

CATALOGUES FREE.



THE STEREOSCOPIC COMPANY,

106 & 108 REGENT STREET, W., & 54, Cheapside, E.C.

Printed by RICHARD CLAY AND SONS, LIMITED, at 7 & 8 Bread Street Hill, Queen Victoria Street, in the City of London and published by MACMILLAN AND CO., LIMITED, at St. Martin's Street, London, W.C., and THE MACMILLAN COMPANY, 66 Fifth Avenue, New York.—THURSDAY, JAN. 4, 1900.



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

No. 1576, Vol. 61]

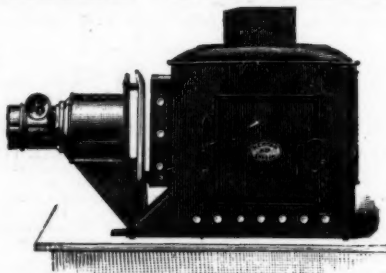
THURSDAY, JANUARY 11, 1900.

[PRICE SIXPENCE

Registered as a Newspaper at the General Post Office.]

[All Rights are Reserved.]

NEWTON & CO.'S "CLASS LANTERN."



Fitted with Incandescent Gas Burner, complete in Case, £4 15s.

This Lantern can also be fitted with an Oil Lamp or Limelight.

NEW CATALOGUE OF LANTERNS, PROJECTION APPARATUS,
SCIENTIFIC AND EDUCATIONAL SLIDES, SIX STAMPS.

NEWTON & CO., 3 FLEET STREET, LONDON.

BECK'S NEW MICROSCOPE THE "BRITISH STUDENTS."

Microscope Stand No. 55, as
figured, with Iris Diaphragm,
One Eye-piece; Double Nose-
piece, Two Object-glasses, 2/8"
and 1/8", adjusted to be in
about focus, and the whole
packed in polished Mahogany
Case,

£6 : 8 : 6

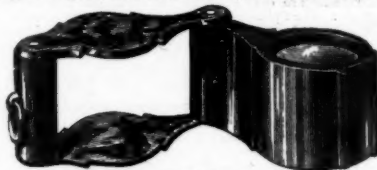


No. 55.

R. & J. BECK, Ltd.,
68 CORNHILL, LONDON, E.C.

BROWNING'S PLATYSCOPIC LENS.

With Larger Angles, Increased Field, and Improved Definition



Engraved Real Size.

AN ACHROMATIC COMBINATION,

COMBINING THE DEFINITION OF A MICROSCOPE WITH THE
PORTABILITY OF A POCKET LENS.

"If you carry a small Platyscopic Pocket Lens (which every observer of
Nature ought to do)."—GRANT ALLEN in *Knowledge*.

The Platyscopic Lens is invaluable to botanists, mineralogists, or ento-
mologists, as it focuses about three times as far from the object as the
Coddington Lenses. This allows opaque objects to be examined easily.

The Platyscopic Lens is made of four degrees of power, magnifying
respectively 10, 15, 20, and 30 diams.; the lowest power, having the largest
field, is the best adapted for general use.

The Lenses are set in Ebonite Cells, and mounted in Tortoiseshell Frames.

Price of the Platyscopic Lens, mounted in Tortoiseshell, magnifying either

10, 15, 20, or 30 diameters, each power, 15s.

In nickel-plated German Silver, each power, 17s. 6d.

Illustrated Description sent free.

JOHN BROWNING, 63 STRAND, LONDON, W.C.

NEGRETTI & ZAMBRA'S TELESCOPES AND BINOCULARS, FOR MILITARY SERVICE.



THE "ARMY SIGNALLING" TELESCOPE,

As supplied to the War Office.

PRICE £2 2s.

Larger size, same pattern, with panoramic eye-pieces,

£4 4s. 0d. and £5 5s. 0d.

Magnifying power, 25 to 35. 30 to 40.

General Illustrated Price Lists of Field Glasses and Telescopes
free by Post to all parts of the world.

NEGRETTI & ZAMBRA,
38 HOLBORN VIADUCT, E.C.

Branches: 45 CORNHILL; 122 REGENT STREET.

UNIVERSITY OF WALES. MATRICULATION EXAMINATION, 1900.

The University Court will shortly appoint MATRICULATION EXAMINERS as follows:—

Subjects.	Present Examiners.
English Language and the History of England and Wales	*Professor J. W. Hales, M.A. Professor J. K. Laughton, M.A.
Mathematics	*R. B. Hayward, M.A., F.R.S. Major P. A. McMahon, R.A., F.R.S. E. S. Shuckburgh, M.A.
Latin	*Professor E. A. Sonnenschein, M.A.
Greek	*R. D. Hicks, M.A.
Welsh	Professor John Rhys, M.A., LL.D.
French	H. E. Berthon, B. Sc. L.
German	*Professor Kuno Meyer, Ph.D., M.A.
Dynamics	*Professor G. M. Minchin, M.A., F.R.S.
Chemistry	*H. F. Morley, D.Sc., M.A.
Botany	{ Professor J. Reynolds Green, D.Sc., F.R.S.

The Examiners whose names are marked with a * have served for the full period of three years.

Particulars will be given by the REGISTRAR of the University, Brecon, to whom applications must be sent on or before January 30th, 1900.

IVOR JAMES,
Registrar of the University of Wales, Brecon.

December, 1899.

BACTERIOLOGY. BACTERIOLOGICAL DEPARTMENT, KING'S COLLEGE, LONDON.

Director: PROF. CROOKSHANK.

The Laboratories are open daily for Instruction and Research from 10 a.m. to 5 p.m. For Syllabus of Classes apply THE SECRETARY. For Information and Advice as to the Course of Instruction to be selected, application must be made in writing to PROF. CROOKSHANK, or an interview may be obtained by appointment.

SPECIAL CLASSES IN JANUARY.

Two complete Courses of Practical Instruction for Medical Practitioners, Veterinary Surgeons, Analysts, &c., will commence on January 8th.

Demonstrations to the Morning Class (Dr. NEWMAN, D.P.H.) will be given at 11 a.m., and to the Afternoon Class (Dr. NASH, D.P.H.) will be given at 2 p.m.; three days a week, with practical work daily in the Laboratory for THIRTY DAYS.

A Class for Candidates for the D.P.H. (Bacteriology) will commence on January 8th at 10 a.m., and a Time Table arranged to suit the convenience of the Class.

A Class in Clinical Bacteriology, consisting of Demonstrations with practical work, will commence on Wednesday, January 10th (2 to 3.30), and be held on successive Wednesdays for six weeks.

THE LONDON SCHOOL OF TROPICAL MEDICINE

(UNDER THE AUSPICES OF HER MAJESTY'S GOVERNMENT),
CONNAUGHT ROAD, ALBERT DOCK, E.

IN CONNECTION WITH THE HOSPITALS OF THE SEAMEN'S
HOSPITAL SOCIETY.

The next SESSION commences on MONDAY, JANUARY 15, 1900. A Travelling Scholarship of £300 will be offered to Students of the School. The Laboratories, Museum, Library, &c., are open daily. Lectures on Tropical Medicine, Tropical Hygiene and Surgery in the Tropics, are delivered during the Session.

Clinical Instruction is given daily in the wards of the Hospitals. Special arrangements for Board will be made for those who may desire to reside on the premises.

For Prospectus, Syllabus, and other particulars, apply to the Secretary, P. MICHELLI, Esq., Seamen's Hospital, Greenwich, S.E.

ROYAL INSTITUTION OF GREAT BRITAIN.

ALBEMARLE STREET, PICCADILLY, W.

Tuesday next, January 16, at Three o'clock, Prof. E. RAY LANKESTER, M.A., LL.D., F.R.S., Director of the Natural History Departments of the British Museum, Fullerian Professor of Physiology, R.I. First of Twelve Lectures on "The Structure and Classification of Fishes." One Guinea the Course.

Thursday, January 18, at Three o'clock, W. H. R. RIVERS, Esq., M.A., M.D., F.R.C.P. First of Three Lectures on "The Senses of Primitive Man." Half-a-Guinea the Course.

Saturday, January 20, at Three o'clock, Sir HUBERT H. PARRY, Mus. Doc., M.A., D.C.L., Director of the Royal College of Music. First of Three Lectures on "Neglected By-ways in Music" (with Musical Illustrations). Half-a-Guinea the Course.

Friday, January 19, at Nine o'clock, The Right Hon. Lord RAYLEIGH, M.A., D.C.L., LL.D., F.R.S., on "Flight."

B.Sc. (LONDON).—WOMAN Requires Post
in BIOLOGICAL LABORATORY (Botany and Zoology) as DEMONSTRATOR or ASSISTANT LECTURER. Experience.—Apply, "A," NATURE Office.

BIRKBECK INSTITUTION, Breems Buildings, Chancery Lane, E.C.

Science Classes with Practical Work.

DAY AND EVENING CLASSES for University of London B.Sc.; Prelim. Scientific, Inter. M.B. Examinations and for Conjoint Board, Dental and Pharmaceutical Examinations.

EVENING CLASSES in all stages for Science and Art Department Examinations.

HIGHLY-EQUIPPED LABORATORIES.

Chemistry, Physics, Biology (Zoology and Botany), Metallurgy, Geology and Mineralogy, Microscopy.

Prospectus free, Calendar 6d. (Post 8d.) on application to Secretary.

HEATHCOTE SCIENCE LABORATORIES.

These Laboratories are open for RESEARCH work, at any hours or times most convenient for worker, in CHEMISTRY, PHYSICS and BACTERIOLOGY. Facilities for Commercial investigations are supplied. Furnaces and powerful Electrical Currents can be used.

The Fees are at rate of £3 3s. for one month (five days a week, six hours a day). Apparatus supplied free.

Private Laboratory, £4 14s. 6d. a month, or by arrangement.

The above Fees include use of all ordinary Glass and other Apparatus, and use of Accurate Balances and Standard General Instruments, also Furnaces, &c.

9 Heathcote Street, Mecklenburgh Square, | R. C. T. EVANS,
Gray's Inn Road, W.C. | Director.

B.A. AND B.Sc. MATRICULATION, INTERMEDIATE, FINAL.

PREPARATION by CORRESPONDENCE and ORAL TUITION on a THOROUGHLY INDIVIDUAL SYSTEM. Fees based on success.

The STAFF includes Graduates of Oxford, Cambridge, London, and Royal Universities, Science Medallists, Prizemen, Scholars, &c.

SINGLE SUBJECTS TAKEN: Latin, Greek, French, German, Mathematics, Science, Logic, Psychology, Political Economy, &c.

For Terms, &c., address Mr. J. CHARLESTON B.A. (Lond. and Oxon.), The Burlington Classes, 27 Chancery Lane, London, W.C.

Telegrams—"Tunzelmann, London."

THE GENERAL ENGINEERING COMPANY, LTD.,

2 and 4 PENYWERN ROAD, LONDON, S.W.

G. W. DE TUNZELMANN, Managing Director.

Mechanical, Electrical and Chemical Patents experimentally developed and Models constructed for Inventors. Special Machinery and Apparatus designed and carried out to Specification. Every description of Accurate work. Repetition work with all parts interchangeable.

TECHNICAL COLLEGE, HUDDERSFIELD.

PRINCIPAL: S. G. RAWSON, D.Sc.

Applications are invited, not later than January 22nd, for the SENIOR ASSISTANTSHIP in the Chemical Department. Salary, £60 per annum. Further particulars upon application.

THOS. THORP, Secretary.

BECK'S MICROSCOPE, International

Stand, with quantity Fittings, condition as new. Cost over £90, to be sold for half. On View.—Apply, "Ark," 742 Holloway Road, N.

DR. ROBERTS' STAR PHOTOGRAPHS.

Copies Wanted of Vol. I.—"C," NATURE Office.

THE IRISH NATURALIST.

A Monthly Magazine of Irish Zoology, Botany, and Geology. Price 6d.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD PRAEGER, B.A.

Annual Subscription, 5s. Post Free to any Address.

Dublin: EASON & SON, Lrps., 40 Lower Sackville Street (to which Address Subscriptions should be sent).

London: SIMPKIN, MARSHALL, HAMILTON, KENT, & CO., Ltd.

BARGAINS IN SCIENTIFIC BOOKS.

COOKE (M.C.), THE BRITISH FUNGI,
A PLAIN AND EASY ACCOUNT OF, with Coloured
Plates of 40 Species, Revised Edition, Crown 8vo. (pub.
6s.). 2s. 6d.

"The new work on the fungi appears to be equally valuable with those which he has already printed. It contains descriptions of the esculent fungi, the manner in which they are prepared for the table, how to discriminate the nutritious from the poisonous species, details of the principles of their scientific classification, and a tabular arrangement of orders and genera."

— **HANDBOOK OF BRITISH HEPATICA**, containing Descriptions and Figures of the Indigenous Species of *Marchantia*, *Juggermania*, *Riccia*, and *Anthoceros*, Illustrated, Crown 8vo. (pub. 6s.). 2s. 6d.

"Probably no group in the British flora has received so little attention as the Hepaticae. Dr. M. C. Cooke has now filled up the gap by producing a 'Handbook of the British Hepaticae,' containing full descriptions of all the species, about two hundred in number, known to inhabit the British Islands."—*Nature*.

— **MICROSCOPIC FUNGI: an Introduction to the Study of Microscopic Fungi**, Rust, Smut, Mildew, and Mould, Illustrated with 269 Coloured Figures by J. E. SOWERBY, Fifth Edition, Revised and Enlarged, with Appendix of New Species, Crown 8vo. (pub. 6s.). 2s. 6d.

"Those of our readers who are the happy possessors of microscopes would welcome this book with delight, as opening the way to a definite study of a most interesting branch of plant life. The minute fungi, here so faithfully depicted by Mr. Sowerby, and so carefully described by Dr. Cooke, have not only beauty of form and colour, but wonderful life histories."

— **OUR REPTILES AND BATRACHIANS**, a Plain and Easy Account of the Lizards, Snakes, Newts, Toads, Frogs, and Tortoises indigenous to Great Britain, New and Revised Edition, with Original Coloured Pictures of every Species, and numerous Woodcuts, Crown 8vo. (pub. 6s.). 2s. 6d.

Postage 3d. extra on one, or 6d. on four.

H. J. GLAISHER, New and Remainder Bookseller, 57 Wigmore Street, London, W.
Catalogues Post Free on application.

THE SCIENTIFIC ROLL AND MAGAZINE OF SYSTEMATIZED NOTES.

THIS WORK IS A VALUABLE
GUIDE, BIBLIOGRAPHY, AND INDEX TO SCIENCE.

In preparation.

BACTERIA (Botanical Section).

Although these are the simplest of plants, there is probably no group of organisms which exceeds them in interest or importance. Their operations affect the welfare of every member of the community, as also of the whole organic world. A full knowledge of them is essential in all questions bearing upon public and private health, agriculture, the microbial diseases of animals and of plants; and it is important in many industries, such as those dealing with milk, butter, hay, flax, tobacco, and others.

The group will be dealt with in three octavo volumes of about 500 pp. each. The subscription price will be 10s. for each volume, payable on delivery of the first number of the volume; or arrangements may be made to supply only the portions relating to a particular species, genus, or topic, at a proportionately reduced rate. The first volume will be commenced next summer, and if sufficient subscribers support the work, the three volumes will be completed in three years. As all the matter will be systematized, the series will be equivalent to a good bacteriological library, with the advantage that the information on any particular point will be comprised within a comparatively few pages, and not scattered over thousands of pages in a host of journals and books.

The names and addresses of subscribers, and applications for prospectus may be sent to the undersigned.

The undersigned will be glad to hear from PRINTERS willing to give estimates for printing, and from PUBLISHERS willing to consider terms for publishing the above-mentioned work.

A. RAMSAY,
4 Cowper Road, Acton, London, W.

ALBERT EDWARD JAMRACH
(Late CHARLES JAMRACH),
NATURALIST,

180 ST. GEORGE STREET EAST.

Implements of Savage Warfare, Idols, Sacred Masks, Peruvian Pottery, Nets, Ukis China, Lacquers, Gongs, Shells, and other Curios.

CLARENDON PRESS, OXFORD.

Just Published, Volume I., pp. xii + 632, with many
Illustrations. Royal 8vo, Half-Morocco. 28s.

The PHYSIOLOGY of PLANTS,
A TREATISE UPON THE METABOLISM AND
SOURCES OF ENERGY IN PLANTS. By Dr. W.
PFEFFER, Professor of Botany in the University of
Leipzig. Second fully Revised Edition. Translated and
Edited by ALFRED J. EWART, D.Sc., Ph.D., F.L.S.

ANNALS of BOTANY. Edited by
ISAAC BAYLEY BALFOUR, M.A., M.D., F.R.S., D. H.
SCOTT, M.A., F.R.S., and W. G. FARLOW, M.D.;
assisted by other Botanists. Royal 8vo. 14s.

Contents of December Number:

HARPER, R. A.—Cell-Division in Sporangia and Asci (with
Plates XXIV.-XXVI.).

WORSDELL, W. C.—Observations on the Vascular System of
the Female "Flowers" of Coniferae (with Plate XXVII.).

WARD, H. MARSHALL.—Symbiosis, some Methods for use in
the Culture of Algae (with Plate XXVIII.).

DARWIN, F.—On Geotropism and the Localization of the
Sensitive Region (with Plate XXIX.).

WAGER, H.—The Sexuality of the Fungi.

NOTES.

WITH PORTRAIT OF C. DARWIN.

LONDON: HENRY FROWDE.

Just Issued.

WRITE FOR A SPECIMEN COPY.

WILLIAMS & NORCATE'S BOOK CIRCULAR,

NEW SERIES, No. 4 (of the SCIENTIFIC SERIES,
No. 73).

Contains Reviews of, and Notes on, New and Forthcoming Foreign
Publications on MEDICINE, NATURAL HISTORY, CHEMISTRY,
PHYSICS, MATHEMATICS, ASTRONOMY, &c.; and also a List of
Valuable Sets of Periodicals, offered for Sale by

WILLIAMS AND NORCATE,

14 HENRIETTA STREET, COVENT GARDEN, LONDON;

20 SOUTH FREDERICK STREET, EDINBURGH;

AND 7 BROAD STREET, OXFORD.

SECTIONAL MODELS OF STEAM AND GAS ENGINES

MANUFACTURED BY

G. CUSSONS,

THE TECHNICAL WORKS,

LOWER BROUGHTON, MANCHESTER.

Experimental Apparatus for Mechanical
Laboratories.

CUSSONS' PATENT ATWOOD MACHINE WITH
BALL BEARING HEAD.

MODELS OF MACHINE AND BUILDING DETAILS,
GEOMETRY, &c.

SEE EXHIBITS AT THE ENGLISH EDUCATION
EXHIBITION, 1900.

G. CUSSONS, TECHNICAL WORKS, MANCHESTER.

Second Volume.

A SELECTION OF PHOTOGRAPHS OF STARS, STAR CLUSTERS, AND NEBULÆ,

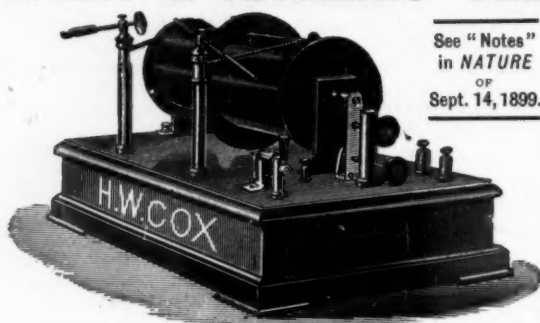
Together with Information concerning the Methods employed in the Pursuit of Celestial Photography (Illustrated by 72 Photographs reproduced in Collotype),

By ISAAC ROBERTS, D.Sc., F.R.S.

Now Ready. Royal Quarto. Price 30s., post free.

LONDON: KNOWLEDGE OFFICE, 326 HIGH HOLBORN, W.C.

X-RAY & ÆTHERIC TELEGRAPHY APPARATUS



See "Notes" in NATURE OF Sept. 14, 1899.

OF THE HIGHEST QUALITY AND FINISH ONLY.

As supplied by us to H.M. Government and the leading Hospitals and X-Ray Workers throughout the World.

We are the actual Manufacturers, and Guarantee every Coil against breaking down.

CALL OR WRITE FOR OUR NEW ILLUSTRATED LIST, WITH TESTIMONIALS AND ILLUSTRATED INSTRUCTIONS, UPON HOW TO WORK. POST FREE TO READERS OF "NATURE."

HARRY W. COX, Ltd.,

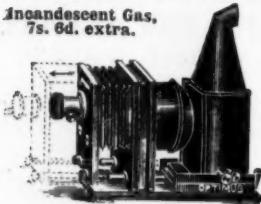
10, 11, 28 CURSITOR STREET,

CHANCERY LANE, LONDON.

Radiographs taken for Scientific and Medical Men, and Demonstrations given.

"OPTIMUS" CANTILEVER PHOTOGRAPHIC ENLARGER.

Incandescent Gas, 7s. 6d. extra.



This already popular model is finished in a very superior and practical style. The lamp gives a brilliant and even light. The optical system is throughout the best. The Lens will be found to give a very flat field and good marginal definition.

* SUITED FOR POCKET CAMERA NEGATIVES.

Diam. of Condenser	... 4in.	5in.	6in.	8in.	10in.
Price, no Front Lens	... 62/-	70/-	80/-	110/-	200/-
Extra for Front Lens	... 27/-	27/-	37/-	63/-	63/-
Covering Plates	... 3 1/2 x 3 1/2	4 1/2 x 3 1/2	6 1/2 x 4 1/2	8 1/2 x 5 1/2	10 1/2 x 7 1/2

Catalogue POST FREE.

PERKEN, SON & CO.,

"OPTIMUS" MAGIC LANTERNS FOR DRAWING ROOM AND LECTURE HALL.

Each Lantern is efficient for Exhibitions. The Lens gives crisp definition, being a superior Achromatic Photographic Combination, with Rack and Pinion, compound Condenser of 4-in. diameter. Each has 3-wick Refulgent Lamp, and is Complete in box. (4-wick Lamp, 2s. extra.)



Mahogany outside Body, Panelled Door, Brass Stages, and 3-draw Sliding Tubes, so that lenses of long focus may be used when projecting upon a screen at a great distance, £5 5s.

Mahogany outside Body, lined with metal, making a thoroughly practical instrument, and really good value ... £2 12 0

Russian Iron Body, Brass Sliding Tubes (Educational)... 3 3 0

Do. do. (College) ... 2 8 0

99 HATTON GARDEN, HOLBORN CIRCUS, E.C. **LONDON.**

HARVEY & PEAK

(BY APPOINTMENT TO THE ROYAL INSTITUTION OF GREAT BRITAIN)

HAVE FOR DISPOSAL A NUMBER OF

NICOL PRISMS AND TOURMALINES of various Sizes.

PROJECTION POLARISCOPES of various Sizes in Stock, with large Nicol Prisms:—

STUDENTS' SPECTROMETERS.—P. O. Bridge Sets, for Schools.—Induction Coils.—Wimshurst Machines.—

X-Ray Apparatus.—Optical Banks, &c., &c.

H. & P. are the actual Manufacturers of the above.

56 CHARING CROSS ROAD, LONDON, W.C.

Apparatus for estimation of sulphur in spent oxide.



FREDK. JACKSON & Co.

(Late MOTTERHEAD & CO.),
14 CROSS STREET, MANCHESTER.

Goods Entrance: 10 Half-Moon Street,

LABORATORY FURNISHERS, Importers, Manufacturers, and Dealers in CHEMICAL AND PHYSICAL APPARATUS

Of every Description.

Fine Chemicals, Volumetric Solutions,
Plain and Stoppered Bottles,AND EVERY LABORATORY REQUIREMENT.
Illustrated Catalogue of Apparatus, with Price List
of Chemicals, free on application.Telegraphic Address—"APPARATUS, MANCHESTER."
Telephone Number—2038.

MOORE'S HYDROSTATIC BALANCE

FOR ILLUSTRATING THE "PRINCIPLE OF
ARCHIMEDES" AND SPECIFIC GRAVITY.A is a delicate spring balance accurately graduated to
read Grams, and is capable of being lowered or raised
by the string shown.B is one of the set of cubes of various metals supplied
with the apparatus.C is a glass vessel with fixed mark etched in glass, up
to which water, or other liquid, is placed. The
vessel is provided with draw-off cock.

Sole Makers of this Apparatus—

BREWSTER, SMITH, & CO.,
6 CROSS STREET, FINSBURY, E.C.Manufacturers and Importers of Chemical and Scientific
Apparatus and Pure Chemicals.WEIGHTS a Speciality, 500 Milligrams to
1 Milligram, 1s. 6d. per doz.SEND FOR COMPLETE ILLUSTRATED
CATALOGUE.

EVERETT & CO., MECHANICAL ENGINEERS AND ELECTRICIANS,

22 CHARTERHOUSE SQUARE, E.C.

Makers of High-Grade Physical and Electrical Apparatus.

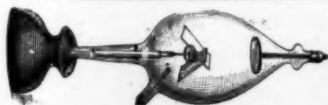
Apparatus designed and made for Laboratories and Research Work.

ALL KINDS OF EXPERIMENTAL WORK.

HIGH-CLASS WORKMANSHIP AND ACCURACY A SPECIALITY.

MODELS DESIGNED, &c.

REPAIRS OF EVERY DESCRIPTION.



GLASS BLOWING

GEISSLER TUBES IN BEAUTIFUL DESIGNS.

TUBES containing specimens of Fluorescent and Phosphorescent
Minerals, Salts, Rubies, &c.ILLUSTRATED TUBE contains Vanes which Fluoresce in three
brilliant colours, and revolve by means of Cathode Rays.**COSSOR, 87 FARRINGTON ROAD, E.C.**

THE AERIAL GRAPHOSCOPE (BRUCE'S PATENT).

Showing Lantern Pictures in Space and Relief without a
Screen, Weird Ghost Effects and Visions, and a variety of
Entirely Original Experiments on Persistence of Vision.Exhibited at the Soirées of the Royal Society, Royal Institution,
Society of Arts, London Institution, &c., &c.The Inventor, **Mr. ERIC STUART BRUCE, M.A.**
Oxon., F.R. Met. Society, can accept Engagements for his
Elaborately Illustrated Lecture on this complete Novelty, also
for shorter Demonstrations at Soirées, Photographic Exhibitions,
and other Entertainments.

APPLY TO

E. S. BRUCE, Esq.,
19 CAMPDEN HOUSE ROAD, KENSINGTON,
LONDON, W.

SPECTROPHOTOGRAPHY.

All requirements for Spectrophotography; Cameras of
wood or metal adapted to any Spectroscope, and fitted with all
necessary adjustments; Spectroscopes specially designed for
photographic work.Prisms and Lenses of Quartz, and Prisms of Iceland Spar
for Photography of the Ultra-Violet Spectrum. Rowland's
Diffraction Gratings always in stock.

ABSORPTION SPECTRA.

Bottle Prisms, with Quartz or Glass Plates; Schulze Cells;
Double Slits, &c., for the study of Absorption Spectra.

THE ZEEMAN EFFECT.

Mr. HILGER is now making Michelson's "Echelon"
Diffraction Gratings. The "Echelon" is the most powerful
instrument yet devised for the minute analysis of fine spectral
lines, and in particular for the observation of the Zeeman Effect.**A. HILGER, 204 Stanhope St., Hampstead Rd., London, N.W.**

NOTICE OF REMOVAL.

W. G. PYE & CO.,
SCIENTIFIC INSTRUMENT MAKERS,

"GRANTA" WORKS,

MILL LANE, CAMBRIDGE

(Late 30 ST. ANDREW'S STREET, CAMBRIDGE).

Beg to inform their numerous Clients that owing to a steady
increase in their business they have found it necessary to
remove to larger premises. With an up-to-date Plant and a
larger Staff they hope to be able to despatch Orders with even
more promptitude than they have hitherto done.**CHEAP AND EFFICIENT APPARATUS FOR
SCIENCE SCHOOLS A SPECIALITY.**CATALOGUES ON APPLICATION AND CORRESPONDENCE
INVITED.

BORD'S PIANOS BECHSTEIN PIANOS

25 per cent. Discount for Cash, or 14/6 per month (second-hand, 10/6 per
month) on the Three Years' System. Lists free of**C. STILES & CO., 40 & 42 Southampton Row, London, W.C.**
PIANOS EXCHANGED.These magnificent Pianos for Hire on the Three Years' System at
advantageous prices and terms. Lists and particulars free of
**CHAS. STILES & CO., 40 & 42 Southampton Row,
LONDON, W.C.**

CHARLES GRIFFIN & CO., LTD.

JUST OUT. SECOND EDITION, Revised, Enlarged, and partly Re-written. 21s. With numerous Illustrations (several Coloured).

CLINICAL MEDICINE.

A Clinical Handbook for Practitioners and Students.

By JUDSON BURY, M.D., F.R.C.P.,

Physician to the Manchester Royal Infirmary.

"We heartily congratulate Dr. Judson Bury on the sterling contribution to medical literature which, in its publication, he has made."—*Dublin Medical Journal*.

JUST OUT. IMPORTANT NEW WORK. 21s.

Large 8vo., Handsome Cloth, with Illustrations and Numerous Tables.

LUBRICATION AND LUBRICANTS:

A Treatise on the Theory and Practice of Lubrication, and on the Nature, Properties, and Testing of Lubricants.

BY

LEONARD ARCHBUTT, & R. MOUNTFORD DEELEY,

F.I.C., F.C.S.,

Chemist to the Midland Railway Company.

M.I.M.E., F.G.S.,

Midland Railway Locomotive Department.

. This work contains valuable information respecting the SOURCES AND PREPARATION OF LUBRICANTS, together with COPIOUS DIRECTIONS for their CHEMICAL AND MECHANICAL VALUATION, and for the DETECTION OF FOREIGN SUBSTANCES AND ADULTERANTS GENERALLY.

JUST OUT. THIRD EDITION. 34s.

Large 8vo., Handsome Cloth, with Frontispiece and 716 Illustrations.

ORE AND STONE MINING.

By C. LE NEVE FOSTER, D.Sc., F.R.S.,

Professor of Mining, Royal College of Science, H.M. Inspector of Mines.

"Undoubtedly the BEST BOOK on the subject in the English language."—*Nature*.

"A book whose WEALTH OF INFORMATION is usually to be found diluted through a whole library of mining literature."—*Engineering and Mining Journal, New York*.

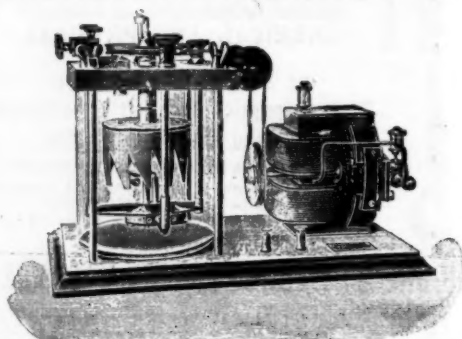
London: CHARLES GRIFFIN & CO., LTD.,
Exeter Street, Strand.

ISENTHAL, POTZLER & CO.,

85 MORTIMER STREET, LONDON, W.

Telegrams: "HYSTERESIS."

Telephone: 2099, GERRARD.

CENTRAL DEPOT for RADIOGRAPHERS.**MERCURY JET INTERRUPTER.**

3000-50,000 Interruptions per Second.

Write for Lists, or better inspect our Installations.

HIGHEST REFERENCES.

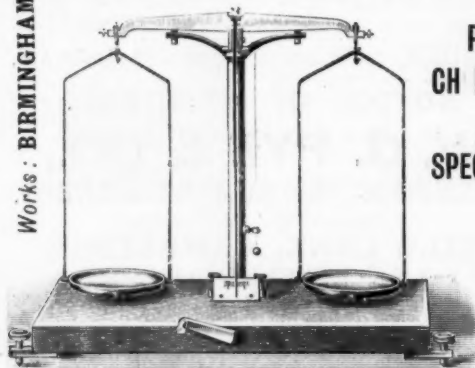
EVERYTHING NOVEL & ORIGINAL.

Sole Agents for Scotland:

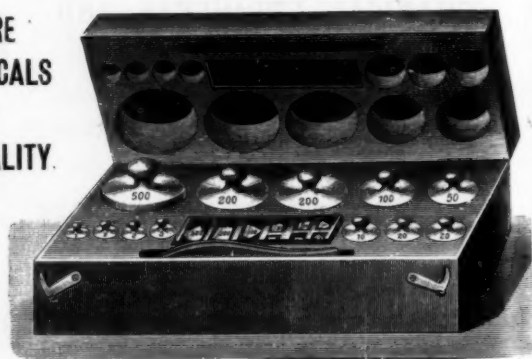
Messrs. JAMES WHITE, Cambridge Street, Glasgow.

EXTRAORDINARY VALUE.

Works: BIRMINGHAM



PURE
CHEMICALS
A
SPECIALITY.

**100 GRAMME BALANCE**

Of VERY BEST FINISH, with

AGATE KNIFE EDGES & BEARINGS,

BEAM SUPPORT, LEVELLING SCREWS,

PLUMB LINE, EXTRA HOOKS.

SENSITIVE to 1 MILLIGRAMME.

£1 : 9 : 6.

COMPLETE SET OF WEIGHTS

IN POLISHED
BOX.

4s.

100 Grammes to
1 Milligramme.

COMPLETE LABORATORY FURNISHERS AND MANUFACTURERS
OF CHEMICAL, PHYSICAL, AND BACTERIOLOGICAL APPARATUS,
INCLUDING THE CELEBRATED "NIVOC" SPECIALITIES.

CATALOGUES ON APPLICATION.

W. & J. GEORGE, LTD., 33-37 HATTON WALL, LONDON.

DINES' PATENT PRESSURE PORTABLE ANEMOMETER.



For many years the want has been felt of a PORTABLE ANEMOMETER, by means of which the actual Velocity and Pressure of the Wind could be quickly ascertained. This want Mr. W. DINES, who is well known for his anemometrical experiments, has met by his PATENT PRESSURE PORTABLE ANEMOMETER.

One scale of the instrument shows *directly* the actual velocity of the wind; the other (not shown in the woodcut) the pressure exerted in pounds per square foot. The instrument is used vertically, with the nozzle pointing towards the wind.

FULL PARTICULARS SENT ON APPLICATION.

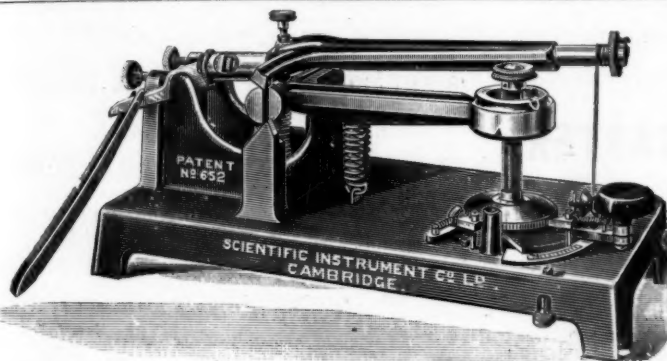
PRICE £3 10 0

L. CASELLA,

SCIENTIFIC INSTRUMENT MAKER TO THE ADMIRALTY AND ORDNANCE,
147 HOLBORN BARS, LONDON, E.C.

Telegraphic Address.
"ESCUTOREON, LONDON."

Telephone.
"1054 Holborn."



THE CAMBRIDGE
SCIENTIFIC INSTRUMENT CO.,
Ltd., CAMBRIDGE.

NEW ROCKING MICROTOME. 1900 PATTERN. [PATENTED.]

This Instrument possesses the following great improvements over the old type of instruments:—
(1) Increased rigidity. (2) The impossibility of cutting thin and thick sections. (3) The impossibility of tearing sections on the upward movement of the object. (4) A graduated arc for showing the thickness of the sections. (5) Catch for holding the object above the edge of the razor. (6) Improved method of fixing the cord. (7) A new object holder.

PRICE (including object holder), £5 0 0

Write for Pamphlet descriptive of the above Instrument.

Address all communications:—
INSTRUMENT COMPANY, CAMBRIDGE.

NEW SCIENCE LANTERN.

SOLE MAKERS:
REYNOLDS & BRANSON,
Ltd.

IMPROVED
PORTABLE
DESIGN.



The Universal Science Lantern has been devised for the projection of experiments. In the short box in front of the lantern is a hinged mirror, so placed that by the movement of a stud it may be introduced and placed at an angle of 45 degrees with the parallel beam. The beam is thus sent upwards through a horizontal convergent lens, on which a slide or horizontal piece of apparatus can be placed. Above this is the objective mounted on a brass pillar, and above the objective a prism or mirror (if the screen is elevated above the lantern plain prisms are required for each beam), silvered on the outside so that there is no double reflection. The mirror can be adjusted to any angle, and is intended to send the image in an approximately horizontal direction to the screen. Slides can also be directly projected in the usual way.

The base-board is made to fold so that the lantern can be packed into a box 18½ x 8½ x 20½ with all its accessories *in situ*.

Price Complete, in Travelling Box, £9 0 0

REYNOLDS & BRANSON, LTD.
14 COMMERCIAL STREET, LEEDS.

PHŒNIX FIRE OFFICE,

19 LOMBARD ST., E.C., and 57 CHARING CROSS, S.W.

ESTABLISHED 1782.

MODERATE RATES. ABSOLUTE SECURITY.
ELECTRIC LIGHTING RULES SUPPLIED.

LIBERAL LOSS SETTLEMENTS.
PROMPT PAYMENT OF CLAIMS.

FRANCIS B. MACDONALD, SECRETARY.

LOSSES PAID OVER £22,000,000.

FINE ART PHOTOGRAPHS.

Assortments sent by Post for Selection to any Part of the World.

No Deposit required from responsible Persons.



"ARTEMIS," by WENCKER.
Folio size at 25.

Paris Salon Pictures, Classical Undraped Figures, Secular and Religious Subjects, Statuary, Views, Yachts, Actresses, Heads, Portraits, Artists' Life Studies (including the celebrated Series by Glooden), Children, Eastern Types, Animals, Flowers, Fruit, Clouds, Waves, Rustic Scenes.

Collections from the National Gallery, South Kensington and British Museums, Louvre, Luxembourg, Vatican, Dresden, and other noted Galleries.

ERDMANN & SCHANZ,
Photographic Publishers and Printers,
(ESTABLISHED 1876),

116½ BEDFORD HILL TERRACE, BALHAM HILL, LONDON, S.W.
Write for our new 52-Page Illustrated Price Catalogue, Post Free, 3d., or the equivalent in Foreign Stamps from Residents abroad.

MINERALS, FOSSILS, ROCKS.

COLLECTIONS OF THIN SLICES FOR PRACTICAL MICROSCOPIC PETROGRAPHICAL STUDY.

(a) Collections of Thin Slices of all important Rock-forming Minerals, for the Demonstration of the occurrence of the same in the Rocks, arranged according to F. Zirkel, "Lehrbuch der Petrographie," 2nd ed., Leipzig, 1893. Collection of 114, respectively, 60 Thin Slices.

Price, in elegant Case, £7; respectively, £3 15s.
(b) New Collection of properly mounted Thin Slices of Rock-forming Minerals, arranged according to H. Rosenbusch, "Microscopic Physiography of Minerals," 3rd. ed., Stuttgart, 1897.

120 Thin Sections of 67 different Minerals in elegant Case £9 0 0
50 " " 34 " " " " " " 3 10 0
(c) Collections of Thin Slices of Rocks, to which will be added a short printed description of all the Specimens and Slices, arranged according to H. Rosenbusch, "Microscopic Physiography of Rocks," 3rd. ed., Stuttgart, 1896.

Collection of ... 120 180 250 Thin Slices.
Price, in elegant Case, £7 10 0 £11 5 0 £16 5 0
THE NEW CATALOGUE OF MINERALS, METEORITES, &c., has just been published, and will be sent, Post free, on application,

Dr. F. KRANTZ,

BONN-ON-THE-RHINE, RHENISH MINERAL OFFICE

ESTABLISHED 1833.

(Represented by Messrs. HARRINGTON BROS., Oliver's Yard, 53A City Road, London, E.C. : and Cork, Ireland.)

WATKINS & DONCASTER,

NATURALISTS, AND MANUFACTURERS OF

CABINETS AND APPARATUS

FOR ENTOMOLOGY, BIRDS' EGGS, AND ALL BRANCHES OF NATURAL HISTORY.

SPECIAL SHOW-ROOM FOR CABINETS.

Call or send for detailed Catalogue (88 pp.), Post free on application.

N.B.—For Excellence and Superiority of Cabinets and Apparatus, references are permitted to distinguished patrons, Museums, Colleges, &c.

A LARGE STOCK OF INSECTS AND BIRDS' EGGS.
Birds, Mammals, &c., Preserved and Mounted by First-class Workmen with true natural surroundings. All Books and Publications on Natural History supplied.

36 STRAND, LONDON, W.C.
(Five Doors from Charing Cross.)

MINERALOGY.

Micro. Slides, Collections and Single Specimens of Minerals, Rocks and Precious Stones, for the Student, Teacher and Prospector.
Elementary Collections in Case, 40 Specimens in Case, 6s. Blowpipe Cases and all necessaries for Field or Class Work.

LESSONS GIVEN.

SAMUEL HENSON,
97 REGENT STREET, LONDON, W.
ESTABLISHED 1840.

MINERALS, ROCKS & FOSSILS.

COLLECTIONS FOR STUDENTS.

Carefully labelled and arranged in Boxes with Card Trays.
50 Minerals, 12/6; 100 do., 21/-; 200 do., 42/-.
Rocks and Fossils at similar prices.
300 Minerals in Cabinet, £4 4s.; 400 do., £5 12s. 6d.
Catalogues Post Free.

THOMAS D. RUSSELL,
78 NEWGATE STREET, LONDON, E.C.
ESTABLISHED 1861.

BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

INVESTED FUNDS

£10,000,000.

The BIRKBECK ALMANACK, with full particulars, post free.
FRANCIS RAVENSCROFT, Manager.

CO-OPERATIVE WORLD TRAVEL

Organised by **HENRY S. LUNN, M.D., F.R.G.S.,**
W. HOLDSWORTH LUNN & CONNOP F. S. PEROWNE.

A Cruise to the EASTERN MEDITERRANEAN.

(Return ticket to MARSEILLES included.)

MARSEILLES, SYRACUSE, PIRÆUS (for Athens),
CONSTANTINOPLE, JAFFA (for Jerusalem), ALEXANDRIA,
MALTA, NAPLES, MARSEILLES.

A THIRTY-FIVE DAYS' CRUISE FOR £36 15s. AND UPWARDS.
A Cruise to GREECE, CONSTANTINOPLE, PALESTINE,
and EGYPT.

(Return Ticket to MARSEILLES included.)

A FORTY-TWO DAYS' CRUISE FOR £44 2s. AND UPWARDS.
S.V. ARGONAUT. Tonnage, 3254; h.-p., 4000.

Full particulars from the Secretary, 5 Endsleigh Gardens,
Euston, London, N.W.

ORIENT COMPANY'S PLEASURE CRUISES

By their Steamship

LUSITANIA (3912 tons register),

For SOUTH of SPAIN, SICILY, PALESTINE, and EGYPT, embarking passengers at London, 13th February, and at Villefranche (Nice), 1st March.

The following places will be visited: CADIZ, TANGIER, MALAGA, PALMA, VILLEFRANCHE, TAORMINA, SANTORIN, KYRENIA, BEYROUT, HAIFA, JAFFA, PORT SAID, ALEXANDRIA (for Cairo), NAPLES, ALGIERS, and GIBRALTAR. The Steamer will arrive back in London on 13th April.

String Band, Electric Light, High-class Cuisine.

Managers { F. GREEN and CO. Head Offices
ANDERSON, ANDERSON, and CO. } Fenchurch Avenue.

For passage apply to the latter Firm, at 5 Fenchurch Avenue, London, E.C.; or to the West End Branch Office, 16 Cockspur Street, S.W.

LIVING SPECIMENS FOR THE MICROSCOPE.

Volvox, Spirogyra, Desmids, Diatoms, Amœba, Arcella, Actinosphaerium, Vorticella, Stentor, Hydra, Floscularia, Stephanoceros, Melicerta, and many other Specimens of Pond Life. Price 2s. per Tube, Post Free. Helix pomatia, Astacus, Amphioxus, Rana, Anodon, &c., for Dissection purposes.

THOMAS BOLTON,

25 BALSALL HEATH ROAD, BIRMINGHAM.

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM.

THE LABORATORY, PLYMOUTH.

The following animals can always be supplied, either living or preserved by the best methods:—

Sycon; Clava, Obelia, Sertularia; Actinia, Tealia, Caryophyllia, Alcyonium; Hormiphora (preserved); Leptopiana; Lineus, Amphiporus; Nereis, Aphrodite, Arenicola, Lanice, Terebella; Lepus, Balanus, Gammarus, Ligia, Mysis, Nebalia, Carcinus; Patella, Buccinum, Eledone, Pecten, Bugula, Crisia, Pedicellina, Holothuria, Asterias, Echinus; Ascidia, Salpa (preserved), Scyllium, Raia, &c., &c.

For prices and more detailed lists apply to
Biological Laboratory, Plymouth.

THE DIRECTOR.

PHYSIOGRAPHY and GEOLOGY.

COLLECTIONS & MICROSCOPIC SLIDES,

As advised by Science and Art Directory, arranged by
JAMES R. GREGORY & CO.,
Mineralogists, &c.,

To Science and Art Department, British, Indian and Colonial
Museums, &c.

NOVELTIES and RARE GEMS and PRECIOUS STONES.

Mineral Specimens for Museums, and Collectors, and all purposes.
Rock Specimens and Microscopic Sections of Rocks and Minerals
cut to order.

NEW AND VALUABLE MINERAL SPECIMENS CONSTANTLY
ARRIVING.

Stores & Offices: 1 Keble Place, KENSINGTON, W.
NEW CATALOGUES AND LISTS FREE.

MACMILLAN & CO.'S NEW BOOKS.

POMPEII: ITS LIFE AND ART. By AUGUST MAU, German Archæological Institute in Rome. Translated by FRANCIS W. KELSEY. With numerous Illustrations from Original Drawings and Photographs. 8vo, handsomely bound in half leather, gilt top. In box, 25s. net.

ST. JAMES'S GAZETTE.—"Here is a wealth of detail, a wealth of description, abundance of scholarly comment, and a rare insight into the conditions and circumstances of men who lived years before we had begun even to make our calendar."

NEW BOOK BY JOHN FISKE.

A CENTURY OF SCIENCE AND OTHER ESSAYS. Crown 8vo, gilt top, 8s. 6d.

A MANUAL OF ZOOLOGY. By the late T. JEFFERY PARKER, D.Sc., F.R.S., Professor of Biology in the University of Otago, Dunedin, New Zealand, and W. A. HASWELL, M.A., D.Sc., F.R.S., Professor of Biology in the University of Sydney, N.S.W. With 300 Illustrations. Crown 8vo, 10s. 6d.

INTRODUCTION TO PHYSICAL CHEMISTRY. By JAMES WALKER, D.Sc., Ph.D., Professor of Chemistry in University College, Dundee. 8vo, 10s. net.

LANCET.—"The book is written in such a lucid way as to render its perusal free from that irksomeness which is so often the student's experience when confronted with theoretical considerations. The book should serve as an admirable introduction to more advanced works."

MACMILLAN AND CO., LIMITED, LONDON.

T. TAMBLYN-WATTS, SCIENTIFIC APPARATUS MAKER.

Catalogue of Electrical Apparatus and Materials, 6d. Post free.

Catalogue of Balances and Weights, Apparatus for the Study of Mechanics, &c., 6d. Post free.

GOLDIELANDS, SETTLE, YORKS.

SECOND-HAND MICROSCOPES

By SWIFT, WATSON, CROUCH, BECK, ZEISS, LEITZ, &c.
Prices from £2 10s. to £45.

A Large Selection of Second-hand Powers and Fittings for all kinds of Microscopes.

Send for New List.

CLARKSON & CO., 28 Bartlett's Buildings, Holborn Circus, E.C.

THE MOST NUTRITIOUS.

E P P S'S

GRATEFUL—COMFORTING.

C O C O A

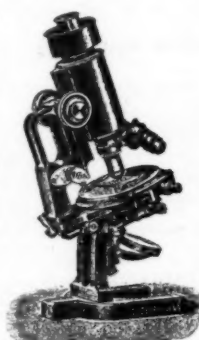
BREAKFAST—SUPPER.

HOLLOWAY'S OINTMENT CURES

Gout, Rheumatism, Lumbago, Sciatica, Cuts, Bruises, Sprains, &c.

INVALUABLE FOR ALL SKIN DISEASES.

Holloway's Ointment and Pills may be obtained of all Medicine Vendors.



CARL ZEISS,

OPTICAL WORKS, JENA.

LONDON BRANCH:

29 MARGARET ST., REGENT ST., W.

NEW

PHOTO-MICROGRAPHIC STAND

With very wide body-tube specially designed for working with our MICRO-PLANARS. It is also fitted with a new Fine-Adjustment of great accuracy and possessing a very slow movement.

These features render this Microscope pre-eminently suitable for Photo-micrography with the highest and lowest powers, as well as for ordinary visual observations.

DESCRIPTIVE PAMPHLET FREE ON APPLICATION.

TO SCIENCE LECTURERS. HUGHES' MOTO-PHOTOSCOPE FOR LIVING PICTURES.

THE MOST PERFECT.

No SHUTTER, therefore no Flickering. Superb Mechanism.

The Moto-Photo Camera for taking the Pictures. Illustrated Lists, &c.

See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN, &c. Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great success. New Oxyhydrogen Microscope. Science Lanterns for Class Demonstration. Magnificent Results. Docwra Triple, Prize Medal, Highest Award. Supplied to the Royal Polytechnic Institution, Dr. H. GRATTAN GUINNESS, Madame ADELINA PATTI, &c., &c. Patent Pamphengos Science Lanterns. The Universal Lantern 4-inch Condensers. 4-wick Lamp, Portrait Combination front Lenses, 18s. 6d., Marvellous value. Science Lecture Sets. Novelties. The Lantern Kaleidoscope. Cheapest Lantern Outfits in the World. Grandly Illustrated Catalogue, over 100 choice Engravings, 6d.; Postage, 3d. List of 300 Lecture Sets, Science Subjects, Views, &c., 6d.; Postage 3d. Pamphlets Free. W. C. HUGHES, SPECIALIST, Brewster House, 82 Mortimer Road, King'sland, N.

NOTICE.—Advertisements and business letters for NATURE should be addressed to the Publishers; Editorial communications to the Editor. The telegraphic address of NATURE is "PHUSIS," LONDON.

SUBSCRIPTIONS TO "NATURE."

	£	s.	d.
Yearly	1	8	0
Half-yearly	0	14	6
Quarterly	0	7	6
TO ALL PLACES ABROAD:—			
Yearly	1	10	6
Half-yearly	0	15	6
Quarterly	0	8	0

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
*Three Lines in Column	0	2	6
Per Line after	0	0	6
One Eighth Page, or Quarter Column	0	18	6
Quarter Page, or Half a Column	1	15	0
Half a Page, or a Column	3	5	0
Whole Page	6	6	0

* The first line being in heavy type is charged for as Two Lines.

Cheques and Money Orders payable to MACMILLAN & CO., Limited.
OFFICE: ST. MARTIN'S STREET, LONDON W.C.

MACMILLAN & CO.'S SCIENCE CLASS BOOKS.

ADAPTED TO THE SOUTH KENSINGTON SYLLABUSES.

I.—PRACTICAL PLANE & SOLID GEOMETRY.

Practical Plane and Solid Geometry. By J. HARRISON, M.Inst.M.E., &c. Instructor in Mechanics and Mathematics, and G. A. BAXANDALL, Assistant Instructor Royal College of Science, London. Part I. ELEMENTARY. 2s. 6d. Part II. ADVANCED. 4s. 6d.

Test Papers in Practical Plane and Solid Geometry. Elementary Stage. By GEORGE GRACE, B.Sc. (Lond.). 24 Tests printed on Cartridge Paper. 2s.

III.—BUILDING CONSTRUCTION.

Building Construction for Beginners. By J. W. RILEY, Rochdale Technical School. 2s. 6d.

V.—MATHEMATICS.

An Elementary Course of Mathematics. Comprising Arithmetic, Algebra, and Euclid. By H. S. HALL, M.A., and F. H. STEVENS, M.A., Masters of the Military Side, Clifton College. 2s. 6d.

Graduated Test Papers in Elementary Mathematics. By WALTER J. WOOD, B.A. 1s.

Practical Mathematics. By F. CASTLE, M.I.M.E. 3s. 6d.

VI.—THEORETICAL MECHANICS.

Mechanics for Beginners. By W. GALLATLY, B.A. 2s. 6d.

Mechanics for Beginners. By Rev. J. B. LOCK, M.A. Part I. Mechanics and Solids. 2s. 6d.

Hydrostatics for Beginners. By F. W. SANDERSON, M.A. 2s. 6d.

VII.—APPLIED MECHANICS.

Lessons in Applied Mechanics. By Prof. J. H. COTTERILL, F.R.S., and J. H. SLADE. 5s. 6d.

VIII.—SOUND, LIGHT, AND HEAT.

Elementary Lessons in Heat, Light, and Sound. By D. E. JONES, B.Sc., Inspector of Science Schools under the Science and Art Department. 2s. 6d.

Heat for Advanced Students. By E. EDSER, A.R.C.Sc. 4s. 6d.

Exercises in Practical Physics for Schools of Science. By Prof. R. A. GREGORY and A. T. SIMMONS, B.Sc. (Lond.). In two parts. Part I. First Year's Course. 2s. Part II. 2s.

Elementary Physics. By BALFOUR STEWART, F.R.S. New Edition, thoroughly Revised. 4s. 6d. Questions. 2s.

IX.—MAGNETISM AND ELECTRICITY.

Electricity and Magnetism for Beginners. By F. W. SANDERSON, M.A. 2s. 6d.

Magnetism and Electricity for Beginners. By H. E. HADLEY, B.Sc. (Lond.). 2s. 6d.

Elementary Lessons in Electricity and Magnetism. By Prof. SILVANUS P. THOMPSON, F.R.S. New Edition. 4s. 6d.

X. & XI.—CHEMISTRY.

INORGANIC CHEMISTRY—THEORETICAL.

Chemistry for Beginners. By Sir HENRY ROSCOE, F.R.S., assisted by J. LUNT, B.Sc. New Edition, revised. 2s. 6d.

The Elements of Chemistry. By Prof. IRA REMSEN. 2s. 6d.

Inorganic Chemistry for Advanced Students. By Sir H. E. ROSCOE, F.R.S., and Dr. A. HARDEN. 4s. 6d.

X & XI.—CHEMISTRY—continued.

Chemical Problems. By Prof. T. E. THORPE, F.R.S. With Key. 2s.

Chemical Arithmetic. By S. LUPTON, M.A. With 1200 Problems. 4s. 6d.

Inorganic Chemistry. By Prof. IRA REMSEN. 6s. 6d.

INORGANIC CHEMISTRY—PRACTICAL.

Chemistry for Organised Schools of Science. By S. PARRISH, B.Sc., A.R.C.S. (Lond.), with Introduction by Dr. FORSYTH. 2s. 6d.

Practical Inorganic Chemistry. By G. S. TURPIN, M.A., D.Sc. 2s. 6d.

Practical Inorganic Chemistry for Advanced Students. By CHAPMAN JONES, F.I.C., F.C.S. 2s. 6d.

The Junior Course of Practical Chemistry. By F. JONES, F.C.S. 2s. 6d. The New Edition of this book covers the Syllabus of the South Kensington Examination.

ORGANIC CHEMISTRY—THEORETICAL.

Organic Chemistry for Beginners. By G. S. TURPIN, M.A., D.Sc. 2s. 6d.

Organic Chemistry. By Prof. IRA REMSEN. 6s. 6d.

XII.—GEOLOGY.

Geology for Beginners. By W. W. WATTS, M.A., F.G.S. 2s. 6d.

XIV.—HUMAN PHYSIOLOGY.

Physiology for Beginners. By Sir MICHAEL FOSTER, K.C.B., and Dr. L. E. SHORE. 2s. 6d.

Physiology for Advanced Students. By A. STANLEY KENT, M.A. (Oxon.). [In preparation.]

Lessons in Elementary Physiology. By the Right Hon. T. H. HUXLEY, F.R.S. 4s. 6d. Questions. 1s. 6d.

XVII.—BOTANY.

Botany for Beginners. By ERNEST EVANS, Burnley Technical School. 2s. 6d.

XIX.—METALLURGY.

A Text-Book of Elementary Metallurgy. By A. H. HIORNS, Principal of the School of Metallurgy, Birmingham and Midland Institute. 3s. Questions. 1s.

XXIII.—PHYSIOGRAPHY.

Experimental Science (Section I. Physiography). By Prof. R. A. GREGORY and A. T. SIMMONS, B.Sc. 2s. 6d.

Physiography for Beginners. By A. T. SIMMONS, B.Sc. 2s. 6d.

Physiography for Advanced Students. By A. T. SIMMONS, B.Sc. 4s. 6d.

Elementary Lessons in Astronomy. By Sir NORMAN LOCKYER, K.C.B. New Edition. 5s. 6d. This book contains all the Astronomy required for the Advanced and Honours Stages.

XXIV.—THE PRINCIPLES OF AGRICULTURE.

Agriculture for Beginners. By A. J. COOPER, Harris Institute, Preston. [In preparation.]

Elementary Lessons in the Science of Agricultural Practice. By H. TANNER, F.C.S. 3s. 6d.

XXV.—HYGIENE.

Hygiene for Beginners. By E. S. REYNOLDS, M.D. 2s. 6d.

Handbook of Public Health and Demography. By E. F. WILLOUGHBY, M.B. New and Revised Edition. 4s. 6d.

MACMILLAN AND CO., LIMITED, LONDON.

NOTICE.—The attention of the readers of this Journal is called to the

NATURE RE-ISSUE

OF THE

INTERNATIONAL SCIENTIFIC SERIES.

EIGHTY-SIX VOLUMES.

**A COMPLETE LIBRARY OF SCIENCE AT
A GREATLY REDUCED PRICE.**

PUBLISHERS' PRICE	...	...	...	...	£21	10	0
BY INSTALMENT (TO-DAY)	...	...	...	...	£14	14	0
FOR CASH	...	...	...	...	£13	10	0

The "International Scientific Series" has a world-wide reputation, and is to be found in every well-equipped Library throughout the English-speaking world. No more generous or acceptable present could be made to any Public Library or individual than this magnificent Encyclopædia of Scientific Research.

Most of the works are illustrated, and many with beautiful coloured plates. The Series has been contributed to by men of science of the highest eminence, such as Tyndall, Herbert Spencer, Walter Bagehot, Alexander Bain, Stanley Jevons, Huxley, Sir John Lubbock, G. J. Romanes, Balfour Stewart, Sir Norman Lockyer, Draper, Bonney, Sir Hubert Parry, Sir E. Maunde Thompson. This list only professes to convey a slight idea of the attention that has been given to the whole Series by the selection of only the best writers to deal with the various subjects considered.

This special offer is open only for a short time, and intending purchasers will do well therefore to send their orders without delay.

For the benefit of those who do not feel disposed to buy the entire Series, it will be possible to secure half the Series, making 43 volumes, for £7 cash, or £7 7s. on the instalment system. The whole Series or half, as the case may be, will be sent on receipt of the first payment of One Guinea—the rest to be paid at the rate of £1 1s. per month.

NOTE:—OFFER OPEN ONLY FOR A SHORT TIME.

ORDER AT ONCE.

A Set of the Volumes may be seen at the Office of NATURE, ST. MARTIN'S STREET, W.C.
A Pamphlet, giving titles, &c., of the Works in the Series, Specimen Pages, with Illustrations, of some of the Volumes, also Order Form, will be sent Post free on application to

C. WORSFOLD, NATURE OFFICE, ST. MARTIN'S STREET, LONDON, W.C.

ORDER FORM.

Date.....1900.

All cheques should be crossed and made payable to C. WORSFOLD, "NATURE" Office, St. Martin's Street, W.C.

I enclose One Guinea as first payment for "NATURE'S Re-issue of the International Scientific Series," and I agree to pay to you, or your representative, the balance at the rate of One Guinea per month; my next payment to be on delivery of the volumes, and my remaining payments on the corresponding day of each month following.

Until such payments are complete, I engage that the Works, not being my property, shall not be disposed of by sale or otherwise.

I further agree that if it be found impossible for any reason to deliver the books, the return of the sum of One Guinea to me shall cancel this agreement.

Name.....

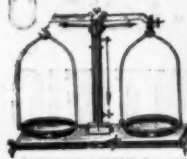
Address.....

Residents abroad are kindly requested to remit in full, or to instruct their representatives in England to make the monthly payments, in order to avoid the expense and delay in forwarding cash from abroad.



HARRIS' ORIGINAL PATTERN ATWOOD MACHINE.
7012A, Accurate and Reliable, 8 to 9 feet high, graduated, £3 15s.

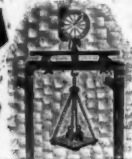
HARRIS' SPECIALITIES.—CATALOGUES UPON APPLICATION.



Reliable Balances, F559A.
100 grm. to 1 mgn. Agate
Planes and Knife Edges.
£1 9s. 6d.; Steel, £1 4s.



Resistance Box, Post
Office, £6 10s.
4775A.



New Mechanical
Apparatus.
See List.



Stroud and Rendell Lantern, £5.
6929A.

PHILIP HARRIS & Co., Ltd.,

COMPLETE LABORATORY FURNISHERS, BIRMINGHAM.

Telegraphic Address :
"Science," Birmingham.
Telephone No. 10.

WATSON'S NEW MICROSCOPES AND APPARATUS.



WATSON'S HOLOSCOPIC EYEPIECES, for use with either **ACHROMATIC** or **ACHROMATIC OBJECTIVES**, an adjustment being provided to the special lenses employed, for altering the correction. There is no sacrifice of efficiency, the performance being equal to the most expensive Compensating or Huyghenian Oculars.

Magnifying Powers—

6 in. tube length, 5, 7, 10, and 14 diameters.
20 in. " 7, 10, 14, and 20 "

PRICE, in Student's Size and Pattern, either power, 17/6 each.

For Full Particulars see Supplemental List, Post Free.

WATSON'S Parachromatic OIL IMMERSION CONDENSER.

Total aperture, 1.30; applanatic aperture exceeds 1.25. Undoubtedly the finest Condenser obtainable for high-power work. Optical part only ... £5 0 0

Completely mounted with Iris Diaphragm and Set of Stops ... £6 10 0

WATSON'S "SCHOOL" MICROSCOPE, New Model, complete with 1 in. Objective, in Case ... £3 3 0

WATSON'S "ROYAL" MICROSCOPE. A new model high-class instrument.

WATSON'S "FRAM" MICROSCOPE. A highest-class instrument at a very moderate cost.

BACTERIOLOGICAL APPARATUS. MICROTOMES. Apparatus for **FIELD BOTANY** and **FIELD GEOLOGY. METAMORPHOSES** and **DISSECTED PREPARATIONS. BOTANICAL and PHYSIOLOGICAL MODELS.**

For Particulars of all the above, see *Watson's New Supplemental List to Catalogue No. 2, Post Free on application.*

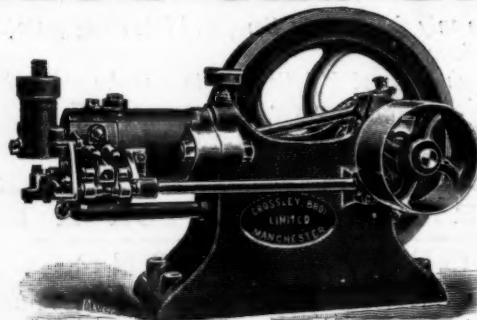
Watson's Catalogue (No. 3) is a Classified List representing a Stock of 40,000 first-class Micro-Slides, Post free on application.

W. WATSON & SONS (Established 1837), Opticians to H.M. Government.

513 HIGH HOLBORN, LONDON, W.C. New Branch Now Open: 16 FORREST ROAD, EDINBURGH. And at 78 Swanston Street, Melbourne, Australia. Awarded 10 Gold and other Medals at the principal International Exhibitions of the World.

CROSSLEY'S GAS ENGINES.

RECENTLY
REMODELLED.



GREAT
REDUCTION
IN
GAS
CONSUMED.

CROSSLEY BROS., LTD., OPENSHAW, MANCHESTER.

THE NEW STIGMATIC LENS.

SERIES II. F/6.

BRITISH DESIGN AND WORKMANSHIP.

Is the best All-round Lens for either Professional or Amateur use.

Each lens will give perfect definition with *full aperture* to the extreme corners of the plate it is sold to cover; with smaller stops it will cover at least two sizes larger, giving perfect sharpness all over the plate, and thus becoming a wide-angle lens of the highest excellence. Either combination may be used separately, giving foci of about 1½ and 2 times the length of that of the lens when used intact. The advantage of thus being able to choose the best point of view, irrespective of distance, will be at once apparent to the artistic worker.

EQUIVALENT TO FOUR LENSES AT THE PRICE OF ONE.

Eleven Sizes are now ready from 3¼ to 18 inches eq. focus.

CATALOGUE OF HIGH-CLASS CAMERAS AND LENSES, POST FREE.

J. H. DALLMEYER, Ltd., 25 NEWMAN STREET, OXFORD STREET, LONDON, W.



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

No. 1577, Vol. 61]

THURSDAY, JANUARY 18, 1900.

[PRICE SIXPENCE.

Registered as a Newspaper at the General Post Office.]

[All Rights are Reserved.

SCOUTING AND OUTPOST TELESCOPE,

AS SUPPLIED TO THE WAR DEPARTMENT FOR
THE OFFICERS AT THE FRONT.



Magnifying 25 diameters, 42/-.

Also in **ALUMINIUM**, very light. Larger sizes up to
£5 : 15 : 6, magnifying 35 diameters.

FIELD GLASSES IN CASE,
40/-, 45/-, 90/-, 100/-.

NEWTON & CO.,
3 FLEET STREET, LONDON.
CATALOGUE, POST FREE.

SHORT BEAM BALANCES.

CHEAP, QUICK-ACTING,
ACCURATE,
KNIFE EDGES AND PLANES OF AGATE
Compensating Stirrup
Suspensors.

To carry 200, 500 grammes.
Price £7. £9 9s.

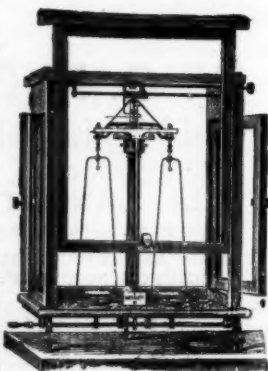
ASSAY BALANCES.

ALUMINIUM BEAMS.
5 Grammes in each Pan.
Indicate $\frac{1}{10}$ m.g.

£10 10s. and £7.

CHEMICAL BALANCE.

ALUMINIUM BEAM.
New design Sliding Rider.
To carry 100 250 grms.
Indicates $\frac{1}{10}$ $\frac{1}{10}$ m.g.
£8 15s. £10 10s.



WRITE for BALANCE CATALOGUE

JOHN J. GRIFFIN & SONS, LD
20-26 SARDINIA STREET, LONDON, W.C.

NOW READY.

THE QUARTERLY REVIEW,

JANUARY 1900. No. 381. Price 6s.

CONTENTS.

- I. BRITISH INTERESTS IN CHINA.
- II. THE GENIUS OF ROME.
- III. GOETHE AND THE NINETEENTH CENTURY.
- IV. OCEAN LINERS.
- V. THE WILD GARDEN.
- VI. THE FOOD OF LONDON. (II.)
- VII. THE SENTIMENT OF THACKERAY.
- VIII. POOR-LAW REFORM.
- IX. THE PERSONALITY OF R. L. STEVENSON.
- X. FRENCH CRIMINAL PROCEDURE.
- XI. THE YEARS BEFORE THE RAID.
- XII. LORD DE TABLEY.
- XIII. THE WAR IN SOUTH AFRICA.

JOHN MURRAY, ALBEMARLE STREET, W.

NEGRETTI & ZAMBRA'S TELESCOPES AND BINOCULARS, FOR MILITARY SERVICE.



THE "ARMY SIGNALLING" TELESCOPE,
As supplied to the War Office.

PRICE £2 2s.

Larger size, same pattern, with panoramic eye-pieces,
£4 4s. 0d. and £5 5s. 0d.

Magnifying power, 25 to 35. 30 to 40.

General Illustrated Price Lists of Field Glasses and Telescopes
free by Post to all parts of the world.

NEGRETTI & ZAMBRA,
38 HOLBORN VIADUCT, E.C.

Branches: 45 CORNHILL; 122 REGENT STREET.

A Second Course of Four Popular and Instructive
LECTURES TO YOUNG PEOPLE

Will be Delivered under the auspices of the Parents' National Educational Union, at the

HORBURY ROOMS, NOTTING HILL GATE, W.

(Two minutes from Notting Hill Gate Station).

On **THURSDAYS, FEB. 1st, 8th, 15th and 22nd**, at 5.15 p.m., entitled

"THE WONDERS OF CREATION,"

By **MR. CECIL CARUS-WILSON, F.R.S.E., &c.**

Fully illustrated by specially selected Photographic Lantern Slides, &c.

Tickets for the Course of Four Lectures:—Children, 4s. 6d.; Adults, 5s. 6d.; one free Ticket being presented to each Teacher with every ten Pupils.

Full particulars and Tickets may be obtained from the Secretary of the P.N.E.U., 28 Victoria Street, Westminster, S.W.; Mrs. Franklin, 50 Porchester Terrace, W.; Mrs. Whitaker-Thompson, 24 Argyll Road, Kensington, W.; or Miss Etta Nauhen, 65 Clarendon Road, W.

Doors open at 4.45. Carriages 6.15.

THE LONDON SCHOOL OF TROPICAL MEDICINE

(UNDER THE AUSPICES OF HER MAJESTY'S GOVERNMENT),
CONNAUGHT ROAD, ALBERT DOCK, E.

IN CONNECTION WITH THE HOSPITALS OF THE SEAMEN'S HOSPITAL SOCIETY.

The next SESSION commences on **MONDAY, JANUARY 15, 1900.** A Travelling Scholarship of £300 will be offered to Students of the School. The Laboratories, Museum, Library, &c., are open daily. Lectures on Tropical Medicine, Tropical Hygiene and Surgery in the Tropics, are delivered during the Session.

Clinical Instruction is given daily in the wards of the Hospitals. Special arrangements for Board will be made for those who may desire to reside on the premises.

For Prospectus, Syllabus, and other particulars, apply to the Secretary, **P. MICHELLI, Esq.**, Seamen's Hospital, Greenwich, S.E.

**MATRICULATION,
 HOSPITAL SCHOLARSHIPS, &c.**

PREPARATION BY CORRESPONDENCE AND ORAL TUITION on a THOROUGHLY INDIVIDUAL SYSTEM. Fees based on success. The STAFF includes Graduates of Oxford, Cambridge, London, and Royal Universities, Science Medallists, Prizemen, Scholars, &c.

SINGLE SUBJECTS TAKEN: Latin, Greek, French, German, Mathematics, Science, Logic, Psychology, Political Economy, &c.

For Terms, &c., address **Mr. J. CHARLESTON, B.A.** (London and Oxon.), The Burlington Classes, 27 Chancery Lane, London, W.C.

**LONDON MATRICULATION AND HOSPITAL
 SCHOLARSHIPS.
 QUERNMORE.**

Special Preparation for the above, Privately, in Class, or by Correspondence, by Messrs. **JOHN GIBSON** (First Class, Cambridge) and **G. LOLY** (First Class, London), with large Staff of Specialist Tutors. Resident Pupils received at Upper Norwood. Long list of successes on application. N.B.—The London Matriculation Guide, with Examination Papers and Solutions (price 1s.), is issued each January and June.

Address: Messrs. **GIBSON & LOLY**, 24 Chancery Lane, W.C.

Telegrams—"Tunzelmann, London."

**THE ELECTRICAL
 AND
 GENERAL ENGINEERING COLLEGE.**

PRESIDENT—**G. W. DE TUNZELMANN, B.Sc. Lond., M.I.E.E.**

PRINCIPAL—**J. H. REEVES, M.A. Cantab.**

Present SESSION began **WEDNESDAY, SEPTEMBER 27.** Particulars on application to the SECRETARY, 2 and 4 Penywern Road, Earl's Court, S.W.

**SCIENCE EXAMINATIONS.
 For LONDON and other UNIVERSITIES, the
 CONJOINT BOARD, &c.**

Well-equipped LABORATORIES, DAY AND EVENING. Personal or Class Tuition.

"R." 9 Heathcote Street, Gray's Inn Road, W.C.

YOUNG LADY CHEMIST, B.Sc. OF

UPSALA, SWEDEN, Author of Scientific Papers, with several years' experience as Analyst, seeks engagement as Assistant to a Chemist or Geologist, or at a Public Laboratory. Excellent references. —Address, SCIENTIST, High School, Maidenhead.

THE TECHNICAL INSTRUCTION

COMMITTEE of the STAFFORDSHIRE COUNTY COUNCIL require the services of a duly qualified SCIENCE MASTER. He will be expected to reside at Stafford, to commence teaching at an early date, and to devote his whole time to the work. The duties will include the conduct of Classes in Chemistry and Physics, and possibly one or more other subjects, at the County Technical Schools, Stafford, and at certain Secondary Schools in the County. Some inspection will also be required. Previous teaching experience essential. Salary, £200 per Annum, together with out-of-pocket expenses.

Applications must be made on or before February 2, 1900, on forms to be obtained from

THOMAS TURNER,

Director of Technical Instruction.

County Technical Offices, Stafford, January 15, 1900.

UNIVERSITY OF GLASGOW.

EXAMINERSHIPS IN MEDICINE.

The University Court of the University of Glasgow will shortly proceed to appoint Three Examiners for Degrees to examine in Midwifery, Medical Jurisprudence and Botany respectively.

The appointment will in each case be as from 1st January last to 31st December, 1903.

The Salary attached to each Examinership is £30 per annum.

Candidates should lodge twenty copies of their application and testimonials with the undersigned on or before Saturday, 3rd February, 1900.

ALAN E. CLAPPERTON,

Secretary of the Glasgow University Court.

91 West Regent Street, Glasgow.

**TECHNICAL COLLEGE,
 HUDDERSFIELD.**

PRINCIPAL: **S. G. RAWSON, D.Sc.**

Applications are invited, not later than January 22nd, for the SENIOR ASSISTANTSHIP in the Chemical Department. Salary, £60 per annum. Further particulars upon application.

THOS. THORP, Secretary.

**SOMERSET COUNTY EDUCATION
 COMMITTEE.**

The Somerset County Education Committee desires to appoint in succession to Mr. Muir, who has accepted another post, a COUNTY INSTRUCTOR in AGRICULTURE, who must have a competent knowledge, both practical and scientific, of Agriculture in general, and Dairy Farming in particular. Salary, £250 per annum, with reasonable travelling and out-of-pocket expenses, and a good house attached to the Experimental Farm. Applications must be sent to the DIRECTOR OF TECHNICAL INSTRUCTION, Weston-super-Mare, not later than Monday, February 5.

Sale by Auction.

PRELIMINARY NOTICE.

TUESDAY AND WEDNESDAY, MARCH 27 AND 28.
 THE "SAMUEL STEVENS" COLLECTION.

MR. J. C. STEVENS begs to announce that

he has received instructions from the Executors to Sell by Auction, at his Great Rooms, 38 King Street, Covent Garden, on Tuesday and Wednesday, March 27 and 28, the well-known Collection of British Lepidoptera and Coleoptera, formed by the late **SAMUEL STEVENS, Esq.**, the result of over sixty years collecting and breeding; consisting probably of over 100,000 specimens, and amongst them some wonderful and exceptional varieties of a very large number of species, and a long series of many rare and extinct species too numerous to mention.

On view day prior, to till 4. Catalogue in preparation, and can be had on application.

W. G. PYE & CO.
 Physical & Physiological Instrument Makers,

"GRANTA" WORKS,

MILL LANE, CAMBRIDGE

(Late 30 ST. ANDREW'S STREET, CAMBRIDGE).

**CHEAP AND EFFICIENT APPARATUS FOR
 SCIENCE SCHOOLS A SPECIALITY.**

Reliable Apparatus at low prices for teaching Mechanics, Hydrostatics, Heat, Optics, Magnetism, Physiology and Electricity, as supplied to many of the leading Technical Institutes and Organised Science Schools.

CATALOGUES ON APPLICATION AND CORRESPONDENCE INVITED.

BARAINS IN SCIENTIFIC BOOKS.

GALTON (F.), FINGER PRINTS, with numerous Illustrations, Square 8vo, Cloth (pub. 6s. net). (Macmillan.) 2s.

Times.—"The whole subject is handled with that rare patience and thoroughness in investigation, and that keen but cautious acumen in interpretation which are characteristic of all Mr. Galton's work."

— **FINGER-PRINT DIRECTORIES**, 8vo, Cloth (pub. 5s. net). (Macmillan.) 1s. 6d.

Full Mail Gazette.—"Indisputably all who are immediately concerned in finger-print Directories will find this volume necessary and suggestive, and valuable to the last degree."

BALFOUR (Prof. J. HUTTON), INTRODUCTION TO THE STUDY OF PALEONTOLOGICAL BOTANY, with 4 Lithographic Plates and upwards of 100 Woodcuts, 8vo (7s. 6d.). (A. and C. Black.) 1s. 3d.

DAVIS (GEORGE E.), PRACTICAL MICROSCOPY, Illustrated with 310 Woodcuts and a Coloured Frontispiece, Third and Revised Edition, 8vo, Cloth (pub. 7s. 6d.). (W. H. Allen.) 3s.

This is the third and enlarged edition, bringing down the subject to the present time; and not only has this been done with regard to English instruments, but the scope of the work has been extended so as to include the apparatus in general use upon the Continent and also in the United States.

Postage 4d. extra on one, or 8d. on four.

H. J. GLAISHER, New and Remainder Bookseller, 57 Wigmore Street, London, W.

Catalogues Post Free on application.

JUST PUBLISHED. 8vo. Price 15s. net.

THE

KINETIC THEORY OF GASES.

ELEMENTARY TREATISE WITH MATHEMATICAL APPENDICES.

By DR. OSKAR EMIL MEYER, Professor of Physics at the University of Breslau.

Translated from the Second Revised Edition by

ROBERT E. BAYNES, M.A.,

Student of Christ Church, Oxford, and Dr. Lee's Reader in Physics.

LONDON: LONGMANS, GREEN, & CO.

PHENIX FIRE OFFICE, 19 LOMBARD ST., E.C., and 57 CHARING CROSS, S.W. ESTABLISHED 1782.

MODERATE RATES. ABSOLUTE SECURITY. ELECTRIC LIGHTING RULES SUPPLIED.

LIBERAL LOSS SETTLEMENTS.

PROMPT PAYMENT OF CLAIMS.

FRANCIS B. MACDONALD, SECRETARY.

LOSSES PAID OVER £22,000,000

Just Published. Price 1s.; per Post, 1s. 4d.

THE VICTORIA UNIVERSITY CALENDAR FOR THE YEAR 1900.

London: MACMILLAN & CO., LTD.

Manchester: J. E. CORNISH.

GLASS BLOWING.

All kinds of Experimental Glass Blowing carried out for Scientific Men, Laboratories, &c.

INVENTORS' IDEAS WORKED OUT AS PER INSTRUCTIONS.

COSSOR,

67 Farringdon Road, E.C.



Shadow of Cross Tube.

JUST OUT.

Demy 8vo, Uncut, Price 31s. 6d. net, by post 32s.

BRITISH DRAGONFLIES:

Being an Exhaustive Treatise on our Native Odonata; their Collection, Classification and Preservation.

By W. J. LUCAS, B.A., F.E.S.

Very fully illustrated with 27 Plates illustrating 39 Species, exquisitely printed in Colour, and numerous Black and White Engravings.

CRIES AND CALL NOTES OF WILD

BIRDS. A Popular description of the notes employed by our commoner British birds in their songs and calls. Illustrated by musical notation. By C. A. WITCHELL. 12s., by post 12s. 2d.

NATURALIST'S DIRECTORY for 1900.

Sixth year of issue. Invaluable to all Students and Collectors. 12s. 6d., by post 12s. 9d.

PRACTICAL TAXIDERMY. A Manual

of Instruction to the Amateur in Collecting, Preserving and Setting up Natural History Specimens of all kinds. By M. BROWNE, F.Z.S. 2nd Edition. 7s. 6d., by post 7s. 10d.

BOOK OF BRITISH HAWK MOTHS.

A Popular and Practical Manual for all Lepidopterists. Copiously illustrated from the Author's own exquisite drawings. By W. J. LUCAS, B.A. 3s. 6d., by post 3s. 9d.

VIVARIUM. Snakes, Lizards, and other

Reptiles, and How to Keep them in Confinement. By Rev. G. C. BATEMAN. Illustrated. 7s. 6d. net, by post 8s.

Full Catalogue on Application.

London: L. UPCOTT GILL, 170 Strand, W.C.

THE SCIENTIFIC ROLL AND MAGAZINE OF SYSTEMATIZED NOTES.

THIS WORK IS A VALUABLE

GUIDE, BIBLIOGRAPHY, AND INDEX TO SCIENCE.

In preparation.

BACTERIA (Botanical Section).

Although these are the simplest of plants, there is probably no group of organisms which exceeds them in interest or importance. Their operations affect the welfare of every member of the community, as also of the whole organic world. A full knowledge of them is essential in all questions bearing upon public and private health, agriculture, the microbial diseases of animals and of plants; and it is important in many industries, such as those dealing with milk, butter, hay, flax, tobacco, and others.

The group will be dealt with in three octavo volumes of about 750 pp. each. The subscription price will be 10s. for each volume, payable on delivery of the first number of the volume; or arrangements may be made to supply only the portions relating to a particular species, genus, or topic, at a proportionately reduced rate. The first volume will be commenced next summer, and if sufficient subscribers support the work, the three volumes will be completed in three years. As all the matter will be systematized, the series will be equivalent to a good bacteriological library, with the advantage that the information on any particular point will be comprised within a comparatively few pages, and not scattered over thousands of pages in a host of journals and books.

The names and addresses of subscribers, and applications for prospectus may be sent to the undersigned.

The undersigned will be glad to hear from PRINTERS willing to give estimates for printing, and from PUBLISHERS willing to consider terms for publishing the above-mentioned work.

A. RAMSAY,
4 Cowper Road, Acton, London, W.

ESTABLISHED 1851.

BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

INVESTED FUNDS

£10,000,000.

The BIRKBECK ALMANACK, with full particulars, post free.
FRANCIS RAVENSCROFT, Manager.

CARL ZEISS, OPTICAL WORKS, JENA.
ASTRONOMICAL DEPARTMENT.



Binary Apochromatic Telescope Object-Glasses, free from Secondary Spectrum, for Visual purposes. Aperture from 1.77 to 1.20.

Triple Photo-Visual Object-Glasses, free from Secondary Spectrum and Differences in Focus, for Observation and Photography. Aperture 1.10 to 1.15.

Apochromatic Aplanatic Object-Glasses, with reduced Secondary Spectrum, for Astro-Photography.

Achromatic Eye-Pieces, with long Eye-Distance.

Telescope Object-Glasses made of ordinary Silicate Glasses.

Objectives, Prisms, Eye-Pieces, and all Astronomical Accessories.

Complete Mounts for Telescopes in any desired form and size.

Special Astronomical Catalogue, in German, French or English, free on application.

London Branch: 29 Margaret Street, Regent Street, W.

JAS. SWIFT & SON,
MANUFACTURING OPTICIANS.



SOLELY APPOINTED TO THE A.M. DEPT.
WAR OFFICE, FOR THE SUPPLY
OF MICROSCOPES.

Patent form of Student's Microscope,
fitted with 2/3" and 1/6" Pan-Aplanatic
Objectives, Iris Diaphragm and Oculars,
in Case, from

£5 5s.

These Instruments we have supplied in
numbers to the following Medical Schools,
viz. St. Mary's, St. Bartholomew's, Guy's,
Middlesex, London, and St. Thomas's.

Seven Gold Medals awarded for excel-
lence of manufacture.

Catalogue on Application.

81 TOTTENHAM COURT ROAD, W.

BACTERIOLOGY.

SEND FOR PARTICULARS OF OUR

DPH No. 2 MICROSCOPE, complete at £18 18s.

TO

C. BAKER,

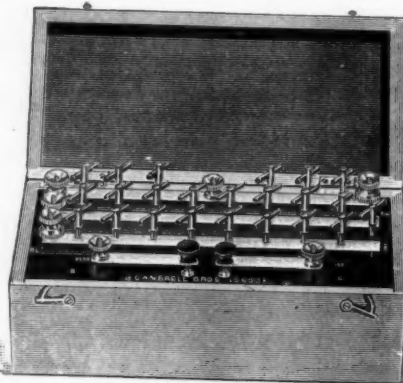
244 HIGH HOLBORN, LONDON.

Also our DPH No. 1 as supplied to the London School
of Tropical Medicine for

BLOOD EXAMINATION.

GAMBRELL BROS.

17 GILTSPUR STREET, LONDON, E.C.



STUDENT'S BRIDGE,

1 to 11,110 Ohms, with three pairs of
Proportional Coils,

£6 : 0 : 0.

PRICES ON APPLICATION FOR ANY FORM OF ELECTRICAL
OR PHYSICAL APPARATUS.

EVERETT & CO.,
MECHANICAL ENGINEERS AND
ELECTRICIANS,

22 CHARTERHOUSE SQUARE, E.C.

Makers of High-Grade Physical and Electrical Apparatus.

Apparatus designed and made for Laboratories and Research Work.

ALL KINDS OF EXPERIMENTAL WORK.

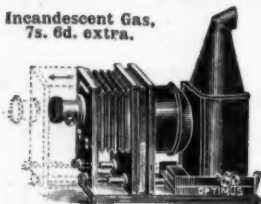
HIGH-CLASS WORKMANSHIP AND ACCURACY A SPECIALITY.

MODELS DESIGNED, &C.

REPAIRS OF EVERY DESCRIPTION.

"OPTIMUS" CANTILEVER PHOTOGRAPHIC ENLARGER.

Incandescent Gas,
7s. 6d. extra.



This already popular model
is finished in a very superior
and practical style. The lamp
gives a brilliant and even light.
The optical system is through-
out the best. The Lens will
be found to give a very flat
field and good marginal defini-
tion.

* SUITED FOR POCKET
CAMERA NEGATIVES.

Diam. of Condenser ...	4in.	5in.	6in.	8in.	10in.
Price, no Front Lens ...	62/-	70/-	80/-	110/-	200/-
Extra for Front Lens ...	27/-	37/-	37/-	63/-	63/-
Covering Plates ...	3 1/2 x 3 1/2	4 1/2 x 3 1/2	6 1/2 x 4 1/2	8 1/2 x 5 1/2	10 1/2 x 8 1/2

Catalogue POST FREE.

PERKEN, SON & CO.,

"OPTIMUS" MAGIC LANTERNS FOR DRAWING ROOM
AND LECTURE HALL.

Each Lantern is efficient for Exhibitions.
The Lens gives crisp definition, being a
superior Achromatic Photographic Combina-
tion, with Rack and Pinion, compound Con-
denser of 4-in. diameter. Each has 3-wick
Refugent Lamp, and is Complete in box.
(4-wick Lamp, 2s. extra.)



Mahogany outside Body, Panelled Door,
Brass Stages, and 3-draw Sliding Tubes, so
that lenses of long focus may be used when
projecting upon a screen at a great distance, £5 5s.

Mahogany outside Body, lined with metal, making a
thoroughly practical instrument, and really good value ... £2 12 0

Russian Iron Body, Brass Sliding Tubes (Educational)... 3 3 0

Do. Do. (College) ... 2 8 0

99 HATTON GARDEN,
HOLBORN CIRCUS, E.C. **LONDON.**

NOTICE.—The attention of the readers of this Journal is called to the

NATURE RE-ISSUE

OF THE

INTERNATIONAL SCIENTIFIC SERIES.

EIGHTY-SIX VOLUMES.

**A COMPLETE LIBRARY OF SCIENCE AT
A GREATLY REDUCED PRICE.**

PUBLISHERS' PRICE	...	...	...	...	£21	10	0
BY INSTALMENT (TO-DAY)	...	...	...	...	£14	14	0
FOR CASH	...	...	...	...	£13	10	0

The "International Scientific Series" has a world-wide reputation, and is to be found in every well-equipped Library throughout the English-speaking world. No more generous or acceptable present could be made to any Public Library or individual than this magnificent Encyclopædia of Scientific Research.

Most of the works are illustrated, and many with beautiful coloured plates. The Series has been contributed to by men of science of the highest eminence, such as Tyndall, Herbert Spencer, Walter Bagehot, Alexander Bain, Stanley Jevons, Huxley, Sir John Lubbock, G. J. Romanes, Balfour Stewart, Sir Norman Lockyer, Draper, Bonney, Sir Hubert Parry, Sir E. Maunde Thompson. This list only professes to convey a slight idea of the attention that has been given to the whole Series by the selection of only the best writers to deal with the various subjects considered.

This special offer is open only for a short time, and intending purchasers will do well therefore to send their orders without delay.

For the benefit of those who do not feel disposed to buy the entire Series, it will be possible to secure half the Series, making 43 volumes, for £7 cash, or £7 7s. on the instalment system. The whole Series or half, as the case may be, will be sent on receipt of the first payment of One Guinea—the rest to be paid at the rate of £1 1s. per month.

NOTE:—OFFER OPEN ONLY FOR A SHORT TIME.

ORDER AT ONCE.

A Set of the Volumes may be seen at the Office of NATURE, ST. MARTIN'S STREET, W.C.

A Pamphlet, giving titles, &c., of the Works in the Series, Specimen Pages, with Illustrations, of some of the Volumes, also Order Form, will be sent Post free on application to

C. WORSFOLD, NATURE OFFICE, ST. MARTIN'S STREET, LONDON, W.C.

ORDER FORM.

Date.....1900.

All cheques should be crossed and made payable to C. WORSFOLD, "NATURE" Office, St. Martin's Street, W.C.

I enclose One Guinea as first payment for "NATURE'S Re-issue of the International Scientific Series," and I agree to pay to you, or your representative, the balance at the rate of One Guinea per month; my next payment to be on delivery of the volumes, and my remaining payments on the corresponding day of each month following.

Until such payments are complete, I engage that the Works, not being my property, shall not be disposed of by sale or otherwise.

I further agree that if it be found impossible for any reason to deliver the books, the return of the sum of One Guinea to me shall cancel this agreement.

Name.....

Address.....

Residents abroad are kindly requested to remit in full, or to instruct their representatives in England to make the monthly payments, in order to avoid the expense and delay in forwarding cash from abroad.

SCOTTISH PROVIDENT INSTITUTION.

HEAD OFFICE: 6 St. Andrew Square, EDINBURGH.

MUTUAL ASSURANCE with MODERATE PREMIUMS.

More than one half of the Members who died during the Septennial period were entitled to Bonuses which, notwithstanding that the premiums do not as a rule exceed the non-profit rates of other Offices, were on the average equal to an Addition of about 50 per cent. to the Policies which participated.

The SURPLUS at last Division was £1,423,000.

Examples of Premium for £100 at Death, with Profits.

AGE.	30*	35	40	45	50	55
DURING LIFE,	£2 1 6	£2 6 10	£2 14 9	£3 5 9	£4 1 7	£5 1 11
25 PAYMENTS,	2 13 0	2 17 9	3 4 6	3 14 0	4 8 7	5 6 11
15 PAYMENTS,	3 12 1	3 18 0	4 5 8	4 16 2	5 11 8	6 9 11

* A person of 30 may secure £1000 at death by a yearly payment, during life, of £20 15s., which would in many Offices secure (with profits) £800 only. Or he may secure £1000 by 25 payments of £26 10s., being thus free of payment before age 55.

ACCUMULATED FUNDS, £11,000,000.

Prospectus, with full information, on application.

LONDON OFFICE: 17 KING WILLIAM STREET, E.C.

J. MUIR LEITCH, Secretary.

C. E. MÜLLER & CO.,

SCIENTIFIC GLASS BLOWERS,

AND MANUFACTURERS OF
CHEMICAL & PHYSICAL APPARATUS,
X-Ray Tubes, Argon and Helium Spectrum Tubes,
Special Apparatus for Research, Chemical
Thermometers, &c., &c.



NEW GEISSLER TUBES.

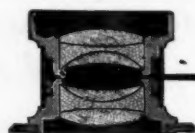
The Flowers appearing in their Natural Colours under the Kathode Rays.

PRICE £1 : 1 : 0

AN ASSORTMENT KEPT IN STOCK.

PRICE LISTS OF CHEMICAL APPARATUS ON APPLICATION.

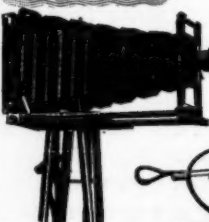
148 HIGH HOLBORN,
LONDON, W.C.



ROSS, Ltd.,

Manufacturers of Celebrated

ROSS' PORTRAIT AND VIEW LENSES
ROSS-ZEISS' ANASTIGMATIC LENSES
ROSS-GÖERTZ' DOUBLE ANASTIGMATS
ROSS' NEW HAND-CAMERA LENSES
ROSS' FIELD AND STUDIO CAMERAS
ROSS' SPECIAL HAND CAMERAS
ROSS' NEW ENLARGING LANTERNS
ROSS' PATENT SCIENCE LANTERNS
ROSS' NEW ECLIPSE MICROSCOPES
ROSS' IMPROVED TELESCOPES
ROSS' FIELD AND OPERA GLASSES
ROSS' NEW PRISMATIC BINOCULARS
&c., &c., &c.



ROSS, Ltd.,

(ESTAB. 1830.)

MANUFACTURING OPTICIANS,
111 NEW BOND ST., LONDON, W.,
AND
31 COCKSPUR ST., CHARING
CROSS, S.W.



IMPROVED D'ARSONVAL GALVANOMETERS.

PRICES

£10-0-0

AND

£4-10-0

LIBERAL DISCOUNTS.

Most
SENSITIVE
for
DEFLECTIVE,
ZERO,
or
BALLISTIC
WORK.

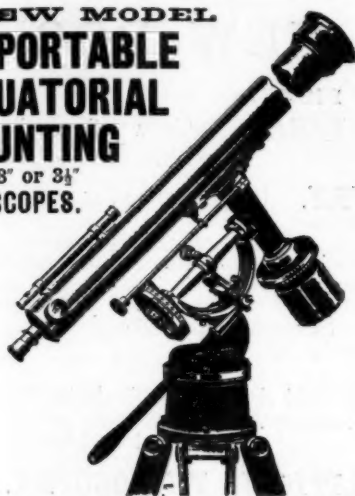


Write for Price List and Particulars of Potentiometers, Galvanometers, Electrical Thermometers, Experimental Direct and Alternating Current Sets, &c., to

CROMPTON & CO., LD.,

Laboratory { "THRIPLANDS," } LONDON, W.

**NEW MODEL
PORTABLE
EQUATORIAL
MOUNTING**
For 3" or 3½"
TELESCOPES.

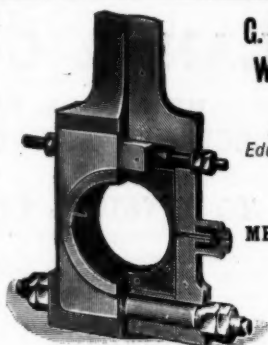


Latitude Adjustment, Clamp for Declination Axis, Quick and Slow Motion, in Right Ascension.

EQUATORIAL MOUNTING with Divided Circles and Stand fitted with short Iron Column, Levelling Screws, and Metal Stretcher, £15 15s.; or, complete with 3" Telescope, £25.

ILLUSTRATED CATALOGUE GRATIS.

J. H. STEWARD,
OPTICIAN,
406 STRAND, 457 WEST STRAND,
7 GRACECHURCH STREET, LONDON.



**G. CUSSONS, TECHNICAL
WORKS, MANCHESTER,**
N.W.

See Exhibits at the English
Education Exhibition, Imperial
Institute, London.

**APPARATUS FOR
MECHANICS, ENGINEERING
AND BUILDING.**

**CUSSONS' NEW
PATENT ATWOOD
MACHINE.**

MACHINE DRAWING.

PHYSICAL APPARATUS (Owens College Set).

For Photography, Unsurpassed for fine definition.

COOKE LENSES

TAYLOR, TAYLOR, & HOBSON,
Stoughton Street Works, Leicester;
and 18 Berners Street, London, W.

ALBERT EDWARD JAMRACH
(Late CHARLES JAMRACH),
NATURALIST,

180 ST. GEORGE STREET EAST.

Implements of Savage Warfare, Idols, Sacred Masks, Peruvian Pottery
Netsukis China, Lacquers, Gongs, Shells, and other Curios.

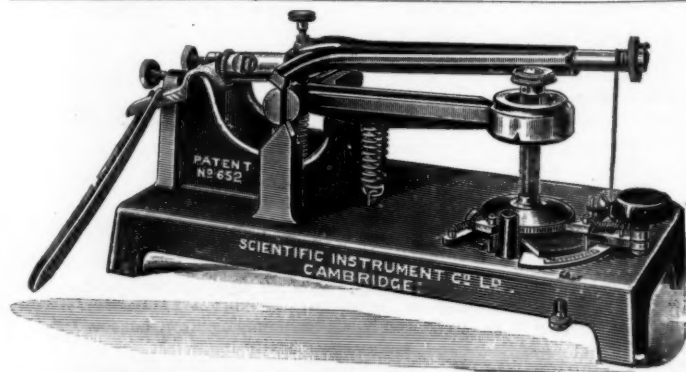
**THE CAMBRIDGE
SCIENTIFIC INSTRUMENT CO.,
Ltd., CAMBRIDGE.**

NEW ROCKING MICROTOME.
1900 PATTERN. [PATENTED.]

This Instrument possesses the following great
improvements over the old type of instruments:—
(1) Increased rigidity. (2) The impossibility of
cutting thin and thick sections. (3) The impos-
sibility of tearing sections on the upward move-
ment of the object. (4) A graduated arc for show-
ing the thickness of the sections. (5) Catch for
holding the object above the edge of the razor.
(6) Improved method of fixing the cord. (7) A new
object holder.

PRICE (including object holder), £5 0 0
Write for Pamphlet descriptive of the above
Instrument.

Address all communications to:—
INSTRUMENT COMPANY, CAMBRIDGE.



"No Better Food."

Dr. ANDREW WILSON, F.R.S.E., &c.

Fry's PURE CONCENTRATED **Cocoa**

250 Gold Medals and Diplomas.

N.B.—Just three words are necessary in order to obtain the right Cocoa,

viz. **FRY'S—PURE—CONCENTRATED.**

MACMILLAN & CO.'S NEW BOOKS.

NEW BOOK BY JOHN FISKE.

A CENTURY OF SCIENCE AND OTHER ESSAYS. Crown 8vo, gilt top, 8s. 6d.

INTRODUCTION TO PHYSICAL CHEMISTRY. By JAMES WALKER, D.Sc., Ph.D., Professor of Chemistry in University College, Dundee. 8vo, 10s. net.

LANCET.—"The book is written in such a lucid way as to render its perusal free from that irksomeness which is so often the student's experience when confronted with theoretical considerations. The book should serve as an admirable introduction to more advanced works."

ELEMENTARY CHEMISTRY. For High Schools and Academies. By ALBERT L. AREY, C.E., Rochester (N. Y.) High School. Crown 8vo, 4s. net.

IRRIGATION AND DRAINAGE. Principles and Practice of their Cultural Phases. By F. H. KING, Professor of Agricultural Physics in the University of Wisconsin; Author of "The Soil." Globe 8vo, 6s. [*Rural Science Series.*]

FRANCIS LIEBER, HIS LIFE AND POLITICAL PHILOSOPHY. By LEWIS R. HARLEY, Ph.D. With Portrait. 8vo, 7s. 6d. net.

NUMBER ONE NOW READY.

THE INTERNATIONAL MONTHLY.

A MAGAZINE OF CONTEMPORARY THOUGHT.

Vol. I. No. I. JANUARY 1900. Price 1s.

CONTENTS.

- Later Evolutions of French Criticisms. By EDOUARD ROD.
 INFLUENCE OF THE SUN UPON THE FORMATION OF THE EARTH'S SURFACE. By N. S. SHALER.
 Organisation among American Artists. By CHARLES DE KAY.
 RECENT ADVANCE IN PHYSICAL SCIENCE. By JOHN TROWBRIDGE.
 The Theatrical Syndicate. By NORMAN HAPGOOD.

MACMILLAN & CO., LIMITED, LONDON.

BORD'S PIANOS

25 per cent. Discount for Cash, or 14/6 per month (second-hand, 10/6 per month) on the Three Years' System. Lists free of
 O. STILES & CO., 40 & 42 Southampton Row, London, W.C.
 PIANOS EXCHANGED.

BECHSTEIN PIANOS

These magnificent Pianos for Hire on the Three Years' System at advantageous prices and terms. Lists and particulars free of
 CHAS. STILES & CO., 40 & 42 Southampton Row, LONDON, W.C.

NOTICE.—Advertisements and business letters for NATURE should be addressed to the Publishers; Editorial communications to the Editor. The telegraphic address of NATURE is "PHUSIS," LONDON.

SUBSCRIPTIONS TO "NATURE."

	£	s.	d.
Yearly	1	8	0
Half-yearly	0	14	6
Quarterly	0	7	6
TO ALL PLACES ABROAD:—			
Yearly	1	10	6
Half-yearly	0	15	6
Quarterly	0	8	0

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
*Three Lines in Column	0	2	6
Per Line after	0	0	9
One Eighth Page, or Quarter Column	0	18	6
Quarter Page, or Half a Column	1	15	0
Half a Page, or a Column	3	5	0
Whole Page	6	6	0

* The first line being in heavy type is charged for as Two Lines.

Cheques and Money Orders payable to MACMILLAN & CO., Limited.
 OFFICE: ST. MARTIN'S STREET, LONDON W.C.

WATKINS & DONCASTER,

**NATURALISTS,
AND MANUFACTURERS OF
CABINETS AND APPARATUS**

FOR ENTOMOLOGY, BIRDS' EGGS, AND ALL BRANCHES OF
NATURAL HISTORY.

SPECIAL SHOW-ROOM FOR CABINETS.

Call or send for detailed Catalogue (66 pp.), Post free on application.

N.B.—For Excellence and Superiority of Cabinets and Apparatus, references are permitted to distinguished patrons, Museums, Colleges, &c.

A LARGE STOCK OF INSECTS AND BIRDS' EGGS.

Birds, Mammals, &c., Preserved and Mounted by First-class Workmen with true natural surroundings. All Books and Publications on Natural History supplied.

36 STRAND, LONDON, W.C.
(Five Doors from Charing Cross.)

MINERALS, ROCKS & FOSSILS.

COLLECTIONS FOR STUDENTS.

Carefully labelled and arranged in Boxes with Card Trays.

50 Minerals, 12/6; 100 do., 21/-; 200 do., 42/-.

Rocks and Fossils at similar prices.

300 Minerals in Cabinet, £4 4s.; 400 do., £5 12s. 6d.

Catalogues Post Free.

THOMAS D. RUSSELL,
78 NEWGATE STREET, LONDON, E.C.

CABINETS

ENTOMOLOGICAL AND ALL BRANCHES OF NATURAL HISTORY.

J. T. CROCKETT & SON are ACTUAL MAKERS.

Great advantages in dealing direct with them.

ALL BEST WORK. ESTIMATES GIVEN.

SEND FOR FULL DETAILED PRICE LIST BEFORE ORDERING ELSEWHERE.

7a PRINCES STREET, CAVENDISH SQUARE, LONDON, W.

Factories: 34 Riding House Street and Ogle Street, W.

PHYSIOGRAPHY and GEOLOGY.

COLLECTIONS & MICROSCOPIC SLIDES,

As advised by Science and Art Directory, arranged by

JAMES R. GREGORY & CO.,

Mineralogists, &c.,

To Science and Art Department, British, Indian and Colonial
Museums, &c.

**NOVELTIES and RARE GEMS and PRECIOUS
STONES.**

Mineral Specimens for Museums, and Collectors, and all purposes.
Rock Specimens and Microscopic Sections of Rocks and Minerals
cut to order.

**NEW AND VALUABLE MINERAL SPECIMENS CONSTANTLY
ARRIVING.**

Stores & Offices: 1 Kelso Place, KENSINGTON, W.
NEW CATALOGUES AND LISTS FREE.

TO SCIENCE LECTURERS.

HUGHES' MOTO-PHOTOSCOPE FOR LIVING PICTURES.

THE MOST PERFECT.

No SHUTTER, therefore no Flickering. Superb Mechanism.

The Moto-Photo Camera for taking the Pictures. Illustrated Lists, &c.

See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN, &c. Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great success. New Oxyhydrogen Microscope. Science Lanterns for Class Demonstration. Magnificent Results. Docwra Triple, Prize Medal! Highest Award. Supplied to the Royal Polytechnic Institution, Dr. H. GRAY-TAN GUINNESS, Madame ADELINA PATTI, &c., &c. Patent Pamphengos Science Lanterns. The Universal Lantern 4-inch Condensers. 4-wick Lamp, Portrait Combination front Lens, 18s. 6d., Marvellous value. Science Lecture Sets. Novelties. The Lantern Kaleidoscope. Cheapest Lantern Outfits in the World. Grandly Illustrated Catalogue, over 150 choice Engravings, 6d.; Postage, 3d. List of 300 Lecture Sets, Science Subjects, Views, &c., 6d.; Postage 3d. Pamphlets Free. W. C. HUGHES, SPECIALIST, Brewster House, 8a Mortimer Road, Kingsland, N.

CO-OPERATIVE WORLD TRAVEL

Organised by HENRY S. LUNN, M.D., F.R.G.S.,
W. HOLDSWORTH LUNN & CONNOP F.S. PEROWNE.

**A Cruise to GREECE, CONSTANTINOPLE, PALESTINE,
and EGYPT.**

(Return Ticket to MARSEILLES included.)

A FORTY-TWO DAYS' CRUISE FOR £44 2s. AND UPWARDS.

s.v. ARGONAUT. Tonnage, 3254; h.-p., 4000.

£10 10s. and £13 13s. TOURS TO ROME.

*Extensions to NAPLES, FLORENCE, VENICE,
and the ITALIAN LAKES.*

Full particulars from the Secretary, 5 Endsleigh Gardens
Euston, London, N.W.

LIVING SPECIMENS FOR THE MICROSCOPE.

Volvox, Spirogyra, Desmids, Diatoms, Amœba, Arcella, Actinosphaerium, Vorticella, Stentor, Hydra, Floscularia, Stephanoceros, Melicerta, and many other Specimens of Pond Life. Price 12. per Tube, Post Free. Helix pomatia, Astacus, Amphioxus, Rana, Anodon, &c., for Dissection purposes.

THOMAS BOLTON,

25 BALSALL HEATH ROAD, BIRMINGHAM.

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM.

THE LABORATORY, PLYMOUTH.

The following animals can always be supplied, either living
or preserved by the best methods:—

Sycon; Clava, Obelia, Sertularia; Actinia, Tealia, Caryophyllia, Alcyonium; Hormiphora (preserved); Leptoplana; Lineus, Amphiporus; Nereis, Aphrodite, Arenicola, Lanice, Terebella; Lepas, Balanus, Gammarus, Ligia, Mysia, Nebalia, Carcinus; Patella, Buccinum, Eledone, Pecten, Bugula, Crisia, Pedicellina, Holothuria, Asterias, Echinus; Ascidia, Salpa (preserved), Scyllium, Raja, &c., &c.

For prices and more detailed lists apply to
Biological Laboratory, Plymouth.

THE DIRECTOR.

THE MOST NUTRITIOUS.

EPPS'S

GRATEFUL—COMFORTING.

C O C O A

BREAKFAST—SUPPER.

THE IRISH NATURALIST.

**A Monthly Magazine of Irish Zoology, Botany, and
Geology. Price 6d.**

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD
PRAEGER, B.A.

Annual Subscription, 5s. Post Free to any Address.

Dublin: EASON & SON, LTD., 40 Lower Sackville Street
(to which Address Subscriptions should be sent).

London: SIMPKIN, MARSHALL, HAMILTON, KENT, & CO., Ltd

HOLLOWAY'S PILLS CURE

**Biliousness, Sick Headache, Indigestion, and
all Internal Complaints.**

CAN BE TAKEN BY THE MOST DELICATE.

Holloway's Pills and Ointment may be obtained of
all Medicine Vendors.

MAGMILLAN & CO.'S BOOKS FOR STUDENTS OF ZOOLOGY.

JUST PUBLISHED.

A MANUAL OF ZOOLOGY.

By the late Prof. T. J. PARKER, D.Sc., F.R.S., and Prof. W. A. HASWELL, M.A., D.Sc., F.R.S.

With Three Hundred Illustrations. Crown 8vo, 10s. 6d.

THE CAMBRIDGE NATURAL HISTORY.

EDITED BY S. F. HARMER, M.A., AND A. E. SHIPLEY, M.A.

TO BE COMPLETED IN TEN VOLUMES. 8vo. PRICE 17s. NET EACH.

WORMS, LEECHES, &c.

VOLUME II.

Flatworms. By F. W. GAMBLE, M.Sc. Vict., Owens College.
Nemertines. By Miss L. SHELDON. **Threadworms,**
&c. By A. E. SHIPLEY, M.A. **Rotifers.** By Professor
MARCUS HARTOG, M.A., D.Sc. Lond. **Polychaet**
Worms. By W. BLAXLAND BENHAM, D.Sc. Lond.,
Hon. M.A. Oxon. **Earthworms and Leeches.** By
F. E. BEDDARD, M.A. Oxon., F.R.S. **Gephyrea,** &c.
By A. E. SHIPLEY, M.A. **Polyzoa.** By S. F.
HARMER, M.A.

SHELLS.

VOLUME III.

Molluscs and Brachiopods. By the Rev. A. H. COOKE,
M.A., A. E. SHIPLEY, M.A., and F. R. C. KEED, M.A.

* * The remaining five volumes, dealing with PROTOZOA
SPIDERS, SCORPIONS, and CRUSTACEA; FISHES and
MAMMALS, are all in active preparation.

A TEXT-BOOK OF ZOOLOGY. By

By T. JEFFERY PARKER, D.Sc., F.R.S., Professor
of Biology in the University of Otago, Dunedin, N.Z.,
and WILLIAM A. HASWELL, M.A., D.Sc., F.R.S.,
Professor of Biology in the University of Sydney, N.S.W.
In Two Vols. With Illustrations. Medium 8vo, 36s. net.

A COURSE OF INSTRUCTION in

ZOOLOGY. **Vertebrata.** By Professor T. JEFFERY
PARKER, F.R.S. With Illustrations. Crown 8vo, 8s. 6d.

A TEXT-BOOK of COMPARATIVE

ANATOMY. By Dr. ARNOLD LANG, Professor of Zoo-
logy in the University of Zürich. With Preface to the
English Translation by Dr. ERNST HAECKEL. Translated
by HENRY M. BERNARD, M.A. Cantab., and MATILDA
BERNARD. Vols. I. and II. (completing the Invertebrates).
8vo. 17s. net each.

LESSONS in ELEMENTARY AN-

ATOMY. By ST. GEORGE MIVART, F.R.S.
Fcap. 8vo. 6s. 6d.

ELEMENTS of the COMPARATIVE

ANATOMY OF VERTEBRATES. Adapted from the
German of Professor WIEDERSHEIM. By Professor W.
NEWTON PARKER. With additions by the Author and
Translator. 270 Woodcuts. Medium 8vo. Second Edition.
12s. 6d. net.

The STRUCTURE of MAN: An IN-

DEX to his PAST HISTORY. By Prof. WIED-
ERSHEIM. Translated by H. and M. BERNARD.
The Translation, Edited and Annotated, and a Preface
written by Professor G. B. HOWES, F.R.S. With 105
Figures in the Text. 8vo. 8s. net.

An INTRODUCTION to the OSTE-

OLOGY OF THE MAMMALIA. By Sir WILLIAM
HENRY FLOWER, F.R.S., F.R.C.S. Illustrated.
Third Edition. Revised with the assistance of HANS
GADOW, Ph.D. Crown 8vo. 10s. 6d.

INSECTS & CENTIPEDES.

VOLUME V.

Peripatus. By ADAM SEDGWICK, M.A., F.R.S. **Myria-**
pods. By F. G. SINCLAIR, M.A. **Insects.** Part I.
By DAVID SHARP, M.A., Cantab., M.B., Edin., F.R.S.

VOLUME VI.

Part II. **Hymenoptera** continued (Tubulifera and Acu-
leata), **Coleoptera**, **Strepsiptera**, **Lepidoptera**,
Diptera, **Aphaniptera**, **Thysanoptera**, **Hemiptera**,
Anoplura. By DAVID SHARP, M.A. Cantab., M.B.
Edin., F.R.S.

BIRDS.

VOLUME IX.

By A. H. EVANS. With numerous Illustrations by G. E. LODGE.

(including Sea Anemones, Jelly Fish, Star Fish, &c.);
THEIR KINDRED; AMPHIBIA and REPTILES; and

ESSAYS ON MUSEUMS AND

OTHER SUBJECTS CONNECTED with NATURAL
HISTORY. By Sir WILLIAM HENRY FLOWER,
K.C.B., D.C.L., D.Sc. Demy 8vo. 12s. net.

A TREATISE on COMPARATIVE

EMBRYOLOGY. By the late Prof. F. M. BALFOUR,
M.A., F.R.S. In two Vols. Second Edition. Medium
8vo. Vol. I. 18s. Vol. II. 21s.

The ELEMENTS of EMBRYOLOGY.

By Sir MICHAEL FOSTER, K.C.B., M.D., F.R.S.,
and the late Prof. F. M. BALFOUR, F.R.S. Second
Edition, revised. Edited by A. SEDGWICK, M.A., and
W. HRAPE, M.A. Illustrated. Crown 8vo. 10s. 6d.

FISHES, LIVING and FOSSIL.

An
Outline of their Forms and probable Relationships. By
BASHFORD DEAN, Ph.D., Instructor in Biology,
Columbia College, New York City. 8vo. 10s. 6d. net.

The NATURAL HISTORY of the

MARKETABLE MARINE FISHES of the BRITISH
ISLANDS. By J. T. CUNNINGHAM, M.A. With
Preface by E. RAY LANKESTER, F.R.S. Illustrated.
Medium 8vo. 7s. 6d. net.

A TEXT-BOOK of ENTOMOLOGY.

including the Anatomy, Physiology, Embryology and
Metamorphoses of Insects, for use in Agricultural and
Technical Schools and Colleges, as well as by the working
Entomologist. By ALPHEUS S. PACKARD, M.D.,
Ph.D., Professor of Zoology and Geology, Brown Univer-
sity. Medium 8vo. 18s. net.

NATURAL HISTORY of AQUATIC

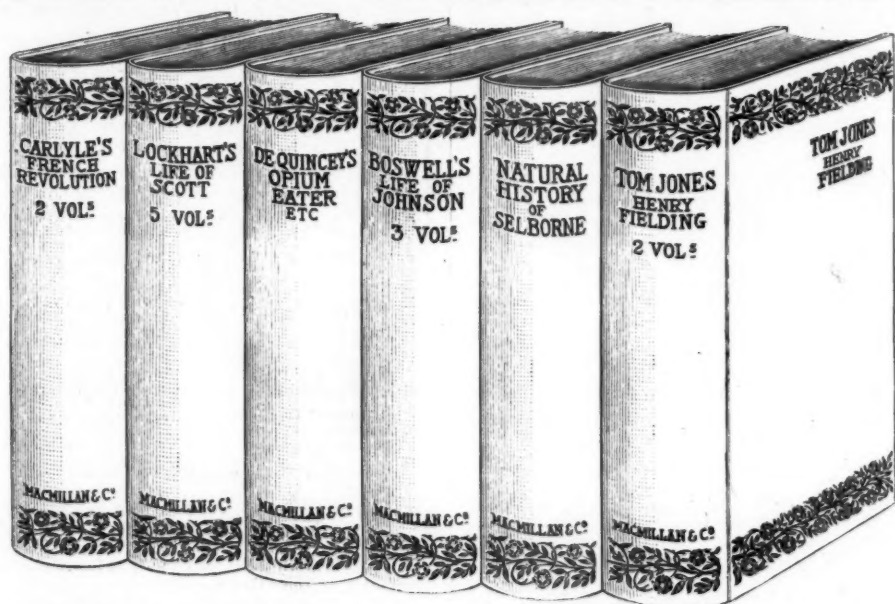
INSECTS. By L. C. MIALL, F.R.S., Professor of
Biology in the Yorkshire College, Leeds. Illustrated.
Crown 8vo. 6s.

THE ORIGIN AND METAMOR-

PHOSES OF INSECTS. By Sir JOHN LUBBOCK,
F.R.S. With Illustrations. 3s. 6d. [Nature Series.

MACMILLAN AND CO., LIMITED, LONDON.

MACMILLAN'S LIBRARY OF ENGLISH CLASSICS.



Under the above title Messrs. MACMILLAN & COMPANY, Limited, propose to issue reprints of various

STANDARD WORKS OF ENGLISH LITERATURE,

for which they believe there is a demand, printed from large type in Demy 8vo volumes, and sold in cloth at the uniform price of 3s. 6d. net per volume. The books will contain neither New Introductions nor New Notes, the idea being to present typographically perfect reprints of the best existing texts. In deciding the question as to which is the best edition to reproduce, the publishers have been fortunate in obtaining the assistance of Mr. A. W. POLLARD, Hon. Sec. of the Bibliographical Society, and beyond a bibliographical note to each book from his pen, the Series will contain no fresh editorial matter.

The aim of the publishers will be to give complete and accurate texts, so that lovers of English Literature may have the opportunity of possessing the works of their favourite writers in a form at once handsome and inexpensive, and printed in the Demy 8vo size, which has always been regarded as most suitable for the study of a private gentleman, and for the shelves of a Public Library.

The publishers hope that if the Series meets with the support they anticipate for it, it may eventually run to a considerable number of volumes, but they do not pledge themselves to bring out more than the twenty-five volumes mentioned below, all of which, however, will appear during the year 1900.

The following is a list of the first twenty-five volumes of the Series:—

Bacon's Essays; Colours of Good and Evil; and Advancement of Learning	1 vol.	[Ready.]	Travels of Sir John Mandeville, with Illustrative Narratives from Hakluyt	1 vol.
Sheridan's Plays	1 vol.	[Ready.]	Lockhart's Life of Scott	5 vols.
Malory's Morte Darthur	2 vols.		Don Quixote translated by Shelton	3 vols.
Sterne's Tristram Shandy and Sentimental Journey	2 vols.		De Quincey's Confessions of an English Opium Eater; Murder as a Fine Art; The English Mail Coach, and other Essays	1 vol.
Boswell's Life of Johnson	3 vols.		Walton's Lives and Complete Angler	1 vol.
Carlyle's French Revolution	2 vols.			
Fielding's Tom Jones	2 vols.			
White's Natural History of Selborne	1 vol.			

A Prospectus may be obtained on application.

MACMILLAN AND CO., LIMITED, LONDON.

The N. & G. Cameras

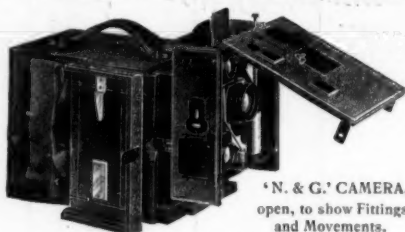
In all sizes up to 7 x 5-in.
For Plates, Cut Films, or Film
in Spools.

For Hand and Tripod.

A Series of High-Class Instruments for Serious Work,
embodying every New Advance in Photography.

Prices from £13 to £50.

Have been in Constant Use for Eight Years in all parts of the World.



'N. & G.' CAMERA,
open, to show Fittings
and Movements.

TRIPOD CAMERAS, SURVEYING CAMERAS, and very Small and
Light POCKET CAMERAS for Travellers and Field Naturalists.

Speciality: COMPLETE OUTFITS for Scientific Expedi-
tions and Special Research.

Catalogues and Estimates Lenses, Kinematographs, Lanterns, and all
free on application. Photographic Accessories and Materials.

Newman & Guardia, Ltd.

90 & 92 Shaftesbury Avenue, London, W.

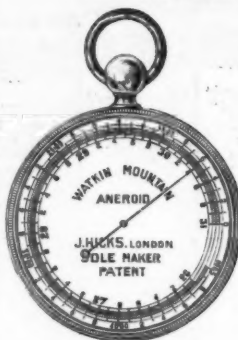
JAS. J. HICKS,

8, 9 & 10, HATTON GARDEN, LONDON,
SCIENTIFIC INSTRUMENT MAKER

TO THE
WAR OFFICE, INDIA OFFICE, ADMIRALTY, &c.,

IS SOLE MAKER OF THE
NEW PATENT

"WATKIN"
MOUNTAIN ANEROID
BAROMETER.



The Barometer that all the World
has been waiting for, and the only
Aneroid that can be thrown in and out
of action as required, and which, when
out of action, is absolutely impervious
to the influence of variations in at-
mospheric pressure. Travellers and
Surveyors will now be able to ascertain
correct altitudes owing to the mar-
vellous accuracy of this Instrument,
which is described at length by Mr.
WHYMPER, the distinguished Alpine
climber, in the "Times" of Dec. 17,
1898. In 65 readings taken between
1227 and 10,289 feet above the sea, the
mean error ascertained by comparison

with the Mercurial Barometer was never so much as 0.2 of an inch. He
says: "Extraordinary results may be obtained from Watkin's Mountain
Aneroid in observations made for altitude, and in determining differences of
level."

"It is beyond doubt a wonderful instrument," &c. (Press).

It is made in Aluminium for lightness, in either 3-inch or 4-
inch sizes, with Sling Leather Case, and supplied at the follow-
ing prices:—Scale to 5000 feet, £5 5s. To 10,000 feet,
£5 10s. To 15,000 feet, £5 15s. To 20,000 feet, £6.

N.B.—Orders will be executed for this Instrument strictly in
the rotation in which they are received.

Full particulars on application.

OPPOSITE THE BRITISH MUSEUM.

THACKERAY HOTEL

(TEMPERANCE).

GREAT RUSSELL STREET, LONDON.

THIS newly-erected and commodious Hotel will, it is believed, meet the requirements of those who desire all the conveniences
and advantages of the larger modern licensed hotels at moderate charges. Passenger Lift. Electric Light in all Rooms. Bath-rooms
on every Floor. Spacious Dining, Drawing, Writing, Reading, and Smoking Rooms. All Floors Fireproof. Perfect Sanitation.
Night Porter. Telephone. Bedrooms from 2s. 6d. to 4s. 6d. per night. Full Tariff and Testimonials on application.

Telegraphic Address: "THACKERAY, LONDON."

Proprietor—J. TRUSLOVE.

Also, amalgamated with, and under the same management,

ESMOND HOTEL

(TEMPERANCE).

MONTAGUE STREET, RUSSELL SQUARE.

THIS Hotel, which has been carried on so successfully for the last 13 years, adjoins the British Museum, and is exception-
ally quiet. Bedrooms from 2s. to 3s. 6d. per night. Full Tariff and Testimonials on application.

Telegraphic Address: "TRUSLOVE, LONDON."

Proprietor—J. TRUSLOVE.

TO SCIENTIFIC MEN, NATURALISTS, TRAVELLERS, AND OTHERS. TWIN-LENS HAND CAMERAS ARE NECESSITIES.

THE

ARTIST

IMPROVED
TWIN-LENS

The Smallest Twin-Lens Hand
Camera in the World.

It measures only 5½ by 6 by 6½ in. and weighs 4½ lbs.,
including three slides, two lenses, and shutter.

It is made of the very finest mahogany, carefully covered in Morocco leather, and is fitted with a full-size
finder and an ordinary focussing screen in addition, so that it is not only the most practical hand
camera, but an equally useful stand ditto. There are three Double Dark Slides, of excellent make and design, or a
Changing Box, holding 12 plates or 20 films; a pair of "Black Band" Rapid Eyroscope Lenses, working at f/5.6;
and a Thornton-Pickard Shutter, with Time and Instantaneous movements and speed regulator, which can be
removed at will. There is a strap for carrying the Camera round the neck when in use, so as to leave the hands at
liberty.

Costs £14 14s. inclusive

Taking Pictures 4½ by 3½.

This Camera can also be supplied in 5 by 4 and 4-plate sizes.

SOLID LEATHER CASE, WITH LOCK, KEY AND HANDLE, 25s. EXTRA.

FREE LESSONS OR DEMONSTRATIONS TO PURCHASERS.

THE STEREOSCOPIC COMPANY

108 and 108 REGENT STREET, W., and 54 Cheapside, E.C.



CATALOGUE FREE.

Printed by RICHARD CLAY AND SONS, LIMITED, at 7 & 8 Bread Street Hill, Queen Victoria Street, in the City of London and published by MACMILLAN
AND CO., LIMITED, at St. Martin's Street, London, W.C., and THE MACMILLAN COMPANY, 66 Fifth Avenue, New York.—THURSDAY, Jan. 18, 1900.

GENERAL LIBRARY,
UNIV. OF MICH.
FEB 7 1900



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

No. 1578, VOL. 61]

THURSDAY, JANUARY 25, 1900.

[PRICE SIXPENCE.

Registered as a Newspaper at the General Post Office.)

(All Rights are Reserved.

NEWTON & CO.'S LOOK-OUT TELESCOPE.

Look-out Telescope, having a 3-in. Object-Glass, Body Tube of Brass, $3\frac{1}{2}$ feet long, fitted with Rack and Sliding Tubes for Adjustment, mounted Altazimuth with Metal Cradle and Bearings on Mahogany Stand, 5 feet high. The Terrestrial Eye-piece will show a church clock at 10 miles distance, and the Astronomical Eye-piece the Moon, Jupiter, Saturn's Ring, and divide many of the Double Stars. £7 10s.

CATALOGUE OF TELESCOPES ON APPLICATION.

NEWTON & CO.

OFFICIANS TO THE QUEEN AND GOVERNMENT,

3 FLEET STREET, LONDON.

BECK'S NEW MICROSCOPE THE "BRITISH STUDENTS."

Microscope Stand No. 55, as figured, with Iris Diaphragm, One Eye-piece; Double Nose-piece, Two Object-glasses, $\frac{2}{3}$ " and $\frac{1}{8}$ ", adjusted to be in about focus, and the whole packed in polished Mahogany Case,

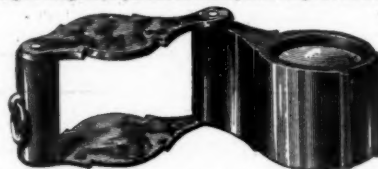
£6 : 8 : 6



No. 55.

R. & J. BECK, Ltd.,
68 CORNHILL, LONDON, E.C.

BROWNING'S PLATYSCOPIC LENS. With Larger Angles, Increased Field, and Improved Definition.



Engraved Real Size.

AN ACHROMATIC COMBINATION,
COMBINING THE DEFINITION OF A MICROSCOPE WITH THE
PORTABILITY OF A POCKET LENS.

"If you carry a small Platyscopic Pocket Lens (which every observer of Nature ought to do)."—GRANT ALLEN in *Knowledge*.

The Platyscopic Lens is invaluable to botanists, mineralogists, or entomologists, as it focuses about three times as far from the object as the Coddington Lenses. This allows opaque objects to be examined easily.

The Platyscopic Lens is made of four degrees of power, magnifying respectively 10, 15, 20, and 30 diams.; the lowest power, having the largest field, is the best adapted for general use.

The Lenses are set in Ebonite Cells, and mounted in Tortoiseshell Frames. Price of the Platyscopic Lens, mounted in Tortoiseshell, magnifying either

10, 15, 20, or 30 diameters, each power, 17s. 6d.

In nickelised German Silver, each power, 17s. 6d.

Illustrated Description sent free.

JOHN BROWNING, 63 STRAND, LONDON, W.C.

NEGRETTE & ZAMBRA'S LONG RANGE BINOCULARS AND TELESCOPES FOR MILITARY PURPOSES.

ILLUSTRATED PRICE LISTS FREE BY POST TO
ALL PARTS OF THE WORLD.

SPECIAL TERMS TO YEOMANRY TROOPS AND VOLUNTEER
CORPS REQUIRING SEVERAL GLASSES.



THE "READY-FOCUS" BINOCULAR.

A great
improvement over the ordinary system
of Focussing.

Invaluable in watching moving
objects.

NEGRETTE & ZAMBRA,
SCIENTIFIC INSTRUMENT MAKERS TO THE QUEEN,
38 HOLBORN VIADUCT, E.C.
BRANCHES: 45 CORNHILL; 122 REGENT STREET.

THE DAVY-FARADAY RESEARCH LABORATORY OF THE ROYAL INSTITUTION.

DIRECTORS:

The Right Hon. LORD RAYLEIGH, M.A., D.C.L.,
LL.D., F.R.S.

Professor DEWAR, M.A., LL.D., F.R.S.

SUPERINTENDENT OF THE LABORATORY:

DR. ALEXANDER SCOTT, M.A., D.Sc., F.R.S.

This Laboratory was founded by Dr. Ludwig Mond, F.R.S., as a Memorial of Davy and Faraday, for the purpose of promoting, by original research, the development and extension of Chemical and Physical Science.

The Laboratory is open free of charge to Workers of either sex, and any nationality, prosecuting individual investigations; and the extensive collection of Physico-Chemical Apparatus presented by the Founder is available for their use, together with such materials, chemicals, electricity, &c., as the Directors may authorise.

Assistants and a trained mechanic are attached to the Laboratory to aid Workers in the prosecution of their researches.

All persons desiring to be admitted as Workers must send evidence of scientific training, qualification, and previous experience in original research, along with a statement of the nature of the investigation they propose to undertake.

Michaelmas Term.—Monday, October 2, to Saturday, December 16.

Lent Term.—Monday, January 8, to Saturday, April 7.

Easter Term.—Monday, April 30, to Saturday, July 28.

Forms of Application can be had from the ASSISTANT SECRETARY, Royal Institution, Albemarle Street, W.

UNIVERSITY OF WALES.

MATRICULATION EXAMINATION, 1900.

The University Court will shortly appoint MATRICULATION EXAMINERS as follows:—

Subjects.	Present Examiners.
English Language and the History of England and Wales	*Professor J. W. Hales, M.A. Professor J. K. Laughton, M.A.
Mathematics	*R. B. Hayward, M.A., F.R.S. Major P. A. McMahon, R.A., F.R.S.
Latin	E. S. Shuckburgh, M.A.
Greek	*Professor E. A. Sonnenschein, M.A.
Welsh	*R. D. Hicks, M.A.
French	Professor John Rhys, M.A., LL.D. H. E. Berthou, B. es. L.
German	*Professor Kuno Meyer, Ph.D., M.A.
Dynamics	*Professor G. M. Minchin, M.A., F.R.S.
Chemistry	*H. F. Morley, D.Sc., M.A.
Botany	Professor J. Reynolds Green, D.Sc., F.R.S.

The Examiners whose names are marked with a * have served for the full period of three years.

Particulars will be given by the REGISTRAR of the University, Brecon, to whom applications must be sent on or before January 30th, 1900.

IVOR JAMES,

Registrar of the University of Wales, Brecon.

December, 1899.

A Second Course of Four Popular and Instructive

LECTURES TO YOUNG PEOPLE

Will be Delivered under the auspices of the Parents' National Educational Union, at the

HORBURY ROOMS, NOTTING HILL GATE, W.

(Two minutes from Notting Hill Gate Station).

On THURSDAYS, FEB. 1st, 8th, 15th and 22nd, at 5.15 p.m., entitled

"THE WONDERS OF CREATION,"

BY MR. CECIL CARUS-WILSON, F.R.S.E., &C.

Fully illustrated by specially selected Photographic Lantern Slides, &c.

Tickets for the Course of Four Lectures:—Children, 4s. 6d.; Adults, 5s. 6d.; one free Ticket being presented to each Teacher with every ten Pupils.

Full particulars and Tickets may be obtained from the Secretary of the P.N.E.U., 28 Victoria Street, Westminster, S.W.; Mrs. Franklin, 50 Port-hester Terrace, W.; Mrs. Whitaker-Thompson, 24 Argyll Road, Kensington, W.; or Miss Eita Nauen, 65 Clarendon Road, W.

Doors open at 4.45. Carriages 6.15.

BIRKBECK INSTITUTION, Breems Buildings, Chancery Lane, E.C.

Science Classes with Practical Work.

DAY AND EVENING CLASSES for University or London B.Sc.; Prelim. Scientific, Inter. M.B. Examinations and for Conjoint Board, Dental and Pharmaceutical Examinations.

EVENING CLASSES in all stages for Science and Art Department Examinations.

HIGHLY-EQUIPPED LABORATORIES.

Chemistry, Physics, Biology (Zoology and Botany), Metallurgy, Geology and Mineralogy, Microscopy.

Prospectus free. Calendar 6d. (Post 8d.) on application to Secretary.

THE LONDON SCHOOL OF TROPICAL MEDICINE

(UNDER THE AUSPICES OF HER MAJESTY'S GOVERNMENT),
CONNAUGHT ROAD, ALBERT DOCK, E.

IN CONNECTION WITH THE HOSPITALS OF THE SEAMEN'S
HOSPITAL SOCIETY.

The next SESSION commences on MONDAY, JANUARY 15, 1900. A Travelling Scholarship of £300 will be offered to Students of the School. The Laboratories, Museum, Library, &c., are open daily. Lectures on Tropical Medicine, Tropical Hygiene and Surgery in the Tropics, are delivered during the Session.

Clinical Instruction is given daily in the wards of the Hospitals.

Special arrangements for Board will be made for those who may desire to reside on the premises.

For Prospectus, Syllabus, and other particulars, apply to the Secretary, P. MICHELLI, Esq., Seamen's Hospital, Greenwich, S.E.

ST. BARTHOLOMEW'S HOSPITAL AND COLLEGE.

PRELIMINARY SCIENTIFIC CLASS.

Systematic Courses of Lectures and Laboratory Work in the subjects of the Preliminary Scientific and Intermediate B.Sc. Examinations of the University of London are held throughout the year.

Attendance on this Class counts as part of the Five Years' Curriculum. Fee for the whole Course £21, or £18 18s. to Students of the Hospital; or single Subjects may be taken.

For further particulars apply to the WARDEN OF THE COLLEGE, St. Bartholomew's Hospital, London, E.C.

A Handbook forwarded on application.

MATRICULATION, HOSPITAL SCHOLARSHIPS, &c.

PREPARATION BY CORRESPONDENCE AND ORAL TUITION ON A THOROUGHLY INDIVIDUAL SYSTEM. Fees based on success.

The STAFF includes Graduates of Oxford, Cambridge, London, and Royal Universities, Science Medallists, Prizemen, Scholars, &c.

SINGLE SUBJECTS TAKEN: Latin, Greek, French, German, Mathematics, Science, Logic, Psychology, Political Economy, &c.

For Terms, &c., address Mr. J. CHARLESTON, B.A. (Lond. and Oxon.), The Burlington Classes, 27 Chancery Lane, London, W.C.

HEATHCOTE SCIENCE LABORATORIES.

These Laboratories are open for RESEARCH work, at any hours or times most convenient for worker, in CHEMISTRY, PHYSICS and BACTERIOLOGY. Facilities for Commercial investigations are supplied. Furnaces and powerful Electrical Currents can be used.

The Fees are at rate of £3 3s. for one month (five days a week, six hours a day). Apparatus supplied free.

Private Laboratory, £4 14s. 6d. a month, or by arrangement.

The above Fees include use of all ordinary Glass and other Apparatus, and use of Accurate Balances and Standard General Instruments, also Furnaces, &c.

9 Heathcote Street, Mecklenburgh Square,
Gray's Inn Road, W.C.

R. C. T. EVANS,
Director.

ROYAL COLLEGE OF SCIENCE, DUBLIN.

DEMONSTRATOR IN BOTANY required from February to June. Salary, £3 per week. Send copies of Testimonials to SECRETARY.

BARGAINS IN SCIENTIFIC BOOKS.

GREENE, F.Z.S. (Dr. W. T.), BIRDS OF THE BRITISH EMPIRE. Many Illustrations, 8vo, Cloth (pub. 7s. 6d.). 2s. 6d.

GORE, F.R.A.S., M.R.I.A., &c. (J. E.), THE WORLDS OF SPACE: a Series of Popular Articles on Astronomical Subjects. Illustrations, Cr. 8vo, Cloth (pub. 7s. 6d.). 1s. 6d.

Postage 4d. extra.

H. J. GLAISHER, New and Remainder Bookseller, 57 Wigmore Street, London, W.

Catalogues Post Free on application.

Fcap. 8vo, Cloth, 1s. net; by Post, 1s. 2d.

THE HUMAN FACE AS EXPRESSIVE OF CHARACTER AND DISPOSITION.

By R. D. STOCKER,

Author of "A Concordance of Graphology and Physiognomy," &c.

The Illustrations include a Portrait of Miss ELLEN BEACH YAW.

"Interesting and suggestive. I have no hesitation in recommending the outcome of his researches to those of my readers who are interested in physiognomy."—*Lady's Pictorial*.

H. J. GLAISHER, 57 Wigmore Street, London, W.; and of all Booksellers.

SOMERSET COUNTY EDUCATION COMMITTEE.

The Somerset County Education Committee desires to appoint in succession to Mr. Muir, who has accepted another post, a COUNTY INSTRUCTOR in AGRICULTURE, who must have a competent knowledge, both practical and scientific, of Agriculture in general, and Dairy Farming in particular. Salary, £950 per annum, with reasonable travelling and out-of-pocket expenses, and a good house attached to the Experimental Farm. Applications must be sent not later than Monday, February 5, to the DIRECTOR OF TECHNICAL INSTRUCTION, Weston-super-Mare, from whom further particulars can be obtained.

The Governors of a PUBLIC SCHOOL

require the services of an Engineering Master, with sound knowledge of Fundamentals, Drawing, Mechanics, Steam Engine and Workshop Experience. Full particulars from O'GORMAN & COZEN-HARDY, 66 Victoria Street, Westminster.

Just Published. Price 1s.; per Post, 1s. 4d.

THE VICTORIA UNIVERSITY CALENDAR FOR THE YEAR 1900.

London: MACMILLAN & CO., LTD.

Manchester: J. E. CORNISH.

Sale by Auction.

PRELIMINARY NOTICE.

TUESDAY AND WEDNESDAY, MARCH 27 AND 28.

THE "SAMUEL STEVENS" COLLECTION.

MR. J. C. STEVENS begs to announce that he has received instructions from the Executors to Sell by Auction, at his Great Rooms, 38 King Street, Covent Garden, on Tuesday and Wednesday, March 27 and 28, the well-known Collection of British Lepidoptera and Coleoptera, formed by the late SAMUEL STEVENS, Esq., the result of over sixty years collecting and breeding; consisting probably of over 100,000 specimens, and amongst them some wonderful and exceptional varieties of a very large number of species, and a long series of many rare and extinct species too numerous to mention. On view day prior, 10 till 4. Catalogue in preparation, and can be had on application.

JUST OUT.

Demy 8vo, Uncut, Price 31s. 6d. net, by post 32s.

BRITISH DRAGONFLIES:

Being an Exhaustive Treatise on our Native Odonata; their Collection, Classification and Preservation.

By W. J. LUCAS, B.A., F.E.S.

Very fully illustrated with 27 Plates illustrating 39 Species, exquisitely printed in Colour, and numerous Black and White Engravings.

CRIES AND CALL NOTES OF WILD

BIRDS. A Popular description of the notes employed by our commoner British birds in their songs and calls. Illustrated by musical notation. By C. A. WITCHELL. 1s., by post 1s. 2d.

NATURALIST'S DIRECTORY for 1900.

Sixth year of issue. Invaluable to all Students and Collectors. 1s. 6d., by post 1s. 9d.

PRACTICAL TAXIDERMY. A Manual

of Instruction to the Amateur in Collecting, Preserving and Setting up Natural History Specimens of all kinds. By M. BROWNE, F.Z.S. 2nd Edition. 7s. 6d., by post 7s. 10d.

BOOK OF BRITISH HAWK MOTHS.

A Popular and Practical Manual for all Lepidopterists. Copiously illustrated from the Author's own exquisite drawings. By W. J. LUCAS, B.A. 3s. 6d., by post 3s. 9d.

VIVARIUM. Snakes, Lizards, and other

Reptiles, and How to Keep them in Confinement. By Rev. G. C. BATEMAN. Illustrated. 7s. 6d. net, by post 8s.

Full Catalogue on Application.

London: L. UPCOTT GILL, 170 Strand, W.C.

Recently Published.

INSECTS: Their Structure & Life.

A PRIMER ON ENTOMOLOGY.

By GEORGE H. CARPENTER, B.Sc.Lond.

Cloth Gilt, 4s. 6d. net.

Knowledge says: "The beginner will here find an elementary account of the chief characteristics of insect life and habits which is altogether trustworthy."

Science Gossip says: "We can recommend Mr. Carpenter's little work as one well worth perusal, and one likely to be useful to its readers."

J. M. DENT & CO., 29 and 30 Bedford Street, W.C.

EVERETT & CO., MECHANICAL ENGINEERS AND ELECTRICIANS,

22 CHARTERHOUSE SQUARE, E.C.

Makers of High-Grade Physical and Electrical Apparatus. Apparatus designed and made for Laboratories and Research Work. ALL KINDS OF EXPERIMENTAL WORK.

HIGH-CLASS WORKMANSHIP AND ACCURACY A SPECIALITY.

MODELS DESIGNED, &c.

REPAIRS OF EVERY DESCRIPTION.

PHOENIX FIRE OFFICE, 19 LOMBARD ST., E.C., and 57 CHARING CROSS, S.W. ESTABLISHED 1782.

MODERATE RATES. ABSOLUTE SECURITY.
ELECTRIC LIGHTING RULES SUPPLIED.

LIBERAL LOSS SETTLEMENTS.

PROMPT PAYMENT OF CLAIMS.

FRANCIS B. MACDONALD, SECRETARY.

LOSSES PAID OVER £22,000,000.

X-RAY & ÆTHERIC TELEGRAPHY APPARATUS



See "Notes"
in NATURE
OF
Sept. 14, 1899.

OF THE HIGHEST QUALITY AND FINISH ONLY,
As supplied by us to H.M. Government and the leading
Hospitals and X-Ray Workers throughout the World.

We are the actual Manufacturers, and Guarantee
every Coil against breaking down.

CALL OR WRITE FOR OUR NEW ILLUSTRATED LIST, WITH
TESTIMONIALS AND ILLUSTRATED INSTRUCTIONS UPON HOW
TO WORK. POST FREE TO READERS OF "NATURE."

HARRY W. COX, Ltd.,
10, 11, 28 CURSITOR STREET,
CHANCERY LANE, LONDON.

Radiographs taken for Scientific and Medical Men, and
Demonstrations given.

MOORE'S HYDROSTATIC BALANCE

FOR ILLUSTRATING THE "PRINCIPLE OF
ARCHIMEDES" AND SPECIFIC GRAVITY.



A is a delicate spring balance accurately graduated to
read Grams, and is capable of being lowered or raised
by the string shown.
B is one of the set of cubes of various metals supplied
with the apparatus.
C is a glass vessel with fixed mark etched in glass, up
to which water, or other liquid, is placed. The
vessel is provided with draw-off cock.

Sole Makers of this Apparatus—

BREWSTER, SMITH, & CO.,
6 CROSS STREET, FINSBURY, E.C.
Manufacturers and Importers of Chemical and Scientific
Apparatus and Pure Chemicals.
WEIGHTS a Speciality, 500 Milligrams to
1 Milligram, 1s. 6d. per doz.
SEND FOR COMPLETE ILLUSTRATED
CATALOGUE.

Apparatus for estimation of sulphur in spent oxide.



FREDK. JACKSON & Co.

(Late MOTTERHEAD & CO.),

14 CROSS STREET, MANCHESTER.

Goods Entrance: 10 Half-Moon Street,

LABORATORY FURNISHERS,
Importers, Manufacturers, and Dealers in
**CHEMICAL AND PHYSICAL
APPARATUS**

Of every Description.

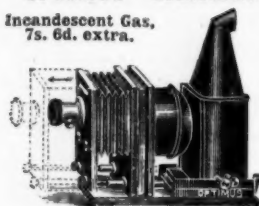
Fine Chemicals, Volumetric Solutions,
Plain and Stoppered Bottles,

AND EVERY LABORATORY REQUIREMENT.
Illustrated Catalogue of Apparatus, with Price List
of Chemicals, free on application.

Telegraphic Address—"APPARATUS, MANCHESTER."
Telephone Number—2038.

"OPTIMUS" CANTILEVER PHOTOGRAPHIC ENLARGER.

Incandescent Gas,
7s. 6d. extra.



This already popular model
is finished in a very superior
and practical style. The lamp
gives a brilliant and even light.
The optical system is through-
out the best. The Lens will
be found to give a very flat
field and good marginal defini-
tion.

* SUITED FOR POCKET
CAMERA NEGATIVES.

Diam. of Condenser ...	* 4in.	5in.	6in.	8in.	10in.
Price, no Front Lens ...	62/-	70/-	80/-	110/-	200/-
Extra for Front Lens ...	27/-	27/-	37/-	63/-	63/-
Covering Plates ...	3 1/2 x 3 1/2	4 1/2 x 3 1/2	6 1/2 x 4 1/2	8 1/2 x 5 1/2 in.	

Catalogue POST FREE.

PERKEN, SON & CO.,

"OPTIMUS" MAGIC LANTERNS FOR DRAWING ROOM AND LECTURE HALL.

Each Lantern is efficient for Exhibitions.
The Lens gives crisp definition, being a
superior Achromatic Photographic Combination,
with Rack and Pinion, compound Con-
denser of 4-in. diameter. Each has 3-wick
Refrugent Lamp, and is Complete in box.
(4-wick Lamp, 2s. extra.)



Mahogany outside Body, Panelled Door,
Brass Stages, and 3-draw Sliding Tubes, so
that lenses of long focus may be used when
projecting upon a screen at a great distance, £5 5s.

Mahogany outside Body, lined with metal, making a thoroughly practical instrument, and really good value ...	£2 12 0
Russian Iron Body, Brass Sliding Tubes (Educational)...	3 3 0
Do. do. (College) ...	2 8 0

99 HATTON GARDEN,
HOLBORN CIRCUS, E.C. **LONDON.**

HARVEY & PEAK

(BY APPOINTMENT TO THE ROYAL INSTITUTION OF GREAT BRITAIN)

HAVE FOR DISPOSAL A NUMBER OF

NICOL PRISMS AND TOURMALINES of various Sizes.

PROJECTION POLARISCOPES of various Sizes in Stock, with large Nicol Prisms:—
STUDENTS' SPECTROMETERS.—P. O. Bridge Sets, for Schools.—Induction Coils.—Wimshurst Machines.—
X-Ray Apparatus.—Optical Banks, &c., &c.

H. & P. are the actual Manufacturers of the above.

56 CHARING CROSS ROAD, LONDON, W.C.

MESSRS. LONGMANS & CO.'S SCIENTIFIC BOOKS.

JUST PUBLISHED. 8vo, 15s. net.

THE KINETIC THEORY OF GASES.

ELEMENTARY TREATISE, WITH MATHEMATICAL APPENDICES.

By Dr. OSKAR EMIL MEYER,

Professor of Physics at the University of Breslau. Second Revised Edition. Translated by ROBERT E. BAYNES, M.A., Student of Christ Church, Oxford, and Dr. Lee's Reader in Physics.

"There is no better book upon its subject, and English students owe a hearty welcome to a translation so thoroughly well done."—*Scotsman*.

"Without doubt the volume will find a place in the libraries of all who make physics and its allied subjects their study."—*Glasgow Herald*.

Complete in THREE VOLUMES, Half-Bound. Vol. I., with 236 Illustrations, 8vo, £2 2s. Vol. II., with 240 Illustrations, 8vo, £2 2s. Vol. III., with 352 Illustrations, 8vo, £3 3s.

A DICTIONARY OF APPLIED CHEMISTRY.

By T. E. THORPE, B.Sc. (Vict.), Ph.D., D.Sc. (Dubl.), F.R.S.,

Professor of Chemistry in the Royal College of Science, London. Assisted by Eminent Contributors.

THE PRINCIPLES OF CHEMISTRY. By D. MENDELÉEFF. Translated from the Russian (Sixth Edition) by GEORGE KAMENSKY, A.R.S.M. of the Imperial Mint, St. Petersburg; and Edited by T. A. LAWSON, B.Sc., Ph.D., Fellow of the Institute of Chemistry. With 96 Diagrams and Illustrations. 2 Vols., 8vo, 36s.

A TEXT-BOOK OF INORGANIC CHEMISTRY. By G. S. NEWTH, F.I.C., F.C.S., Demonstrator in the Royal College of Science, London; Assistant Examiner in Chemistry, Science and Art Department. Fifth Edition. With 146 Illustrations. Crown 8vo, 6s. 6d.

CHEMICAL ANALYSIS, QUANTITATIVE AND QUALITATIVE. By G. S. NEWTH, F.I.C., F.C.S., Demonstrator in the Royal College of Science, London; Assistant Examiner in Chemistry, Science and Art Department. With 100 Illustrations. Crown 8vo, 6s. 6d.

GANOT'S ELEMENTARY TREATISE ON PHYSICS, EXPERIMENTAL AND APPLIED. Translated and Edited from Ganot's "Éléments de Physique," by E. ATKINSON, Ph.D., F.C.S. FIFTEENTH EDITION. Revised and Enlarged. With 9 Coloured Plates, 1057 Illustrations in the Text, and an Appendix of Problems, with Answers. Crown 8vo, 15s.

GANOT'S NATURAL PHILOSOPHY FOR GENERAL READERS AND YOUNG PERSONS. Translated and Edited from Ganot's "Cours Élémentaire de Physique," by E. ATKINSON, Ph.D., F.C.S. EIGHTH EDITION. With 7 Plates, 624 Illustrations in the Text, and an Appendix of Questions. Crown 8vo, 7s. 6d.

A TEXT-BOOK OF PHYSICS. By W. WATSON, B.Sc., Assistant Professor in Physics in the Royal College of Science, London; Assistant Examiner in Physics, Science and Art Department. For use in Technical Schools, Advanced Science and Art Classes, Engineering Schools, Universities, &c., &c. With 564 Illustrations. Large Crown 8vo, 10s. 6d. *[Just published.]*

ELECTRICAL ENGINEERING. For Electric Light Artisans and Students. (Embracing those branches prescribed in the Syllabus issued by the City and Guilds Technical Institute.) By W. SLINGO and R. BROOKER. ENLARGED AND REVISED EDITION. With 359 Illustrations. Crown 8vo, 12s.

THE TESTING OF MATERIALS OF CONSTRUCTION. A Text-book for the Engineering Laboratory and a Collection of the Results of Experiment. By WILLIAM CAWTHORNE UNWIN, F.R.S., M.Inst.C.E., Hon. M.Inst.M.E., Professor of Engineering at the Central Technical College of the City and Guilds of London Institute. SECOND EDITION, REVISED AND ENLARGED. With 5 Plates and 188 Illustrations and Diagrams in the Text. 8vo, 16s. net.

RIVINGTON'S COURSE OF BUILDING CONSTRUCTION.

NOTES ON BUILDING CONSTRUCTION. Arranged to meet the Requirements of the Syllabus of the Science and Art Department of the Committee of Council on Education, South Kensington. Medium 8vo.

PART I. ELEMENTARY STAGE. With 552 Illustrations. 10s. 6d.

PART II. ADVANCED STAGE. With 479 Illustrations. 10s. 6d.

PART III. MATERIALS. Course for Honours. With 188 Illustrations. 21s.

PART IV. CALCULATIONS FOR BUILDING STRUCTURES. Course for Honours. With 597 Illustrations. 15s.

LONGMANS, GREEN, & CO., LONDON, NEW YORK, AND BOMBAY.

ISENTHAL, POTZLER & CO.,

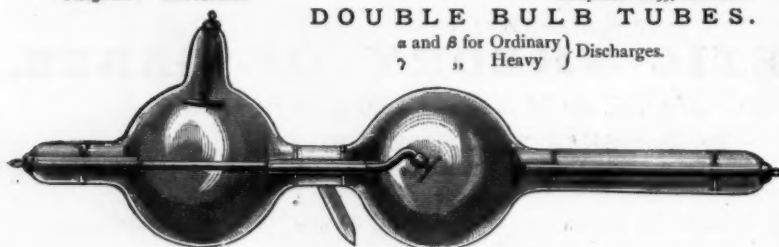
85 MORTIMER STREET, LONDON, W.

Telegram: "HYSTERESIS."

Telephone: 3099, GERRARD.

DOUBLE BULB TUBES.

α and β for Ordinary } Discharges.
" Heavy }

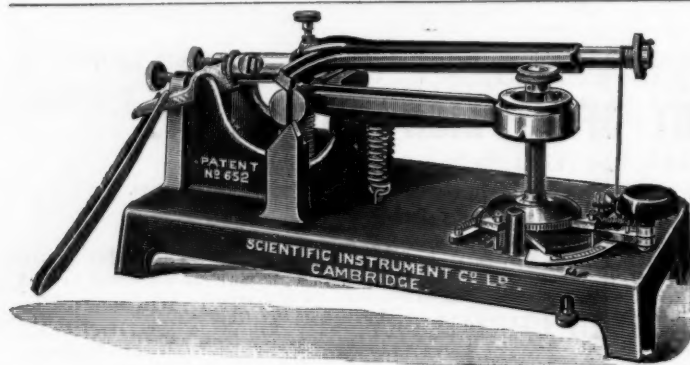


CENTRAL DEPÔT FOR RADIOGRAPHERS.

Write for Lists, or better inspect our Installations.

HIGHEST REFERENCES.
EVERYTHING NOVEL AND ORIGINAL.

SOLE AGENTS FOR SCOTLAND:
Messrs. JAMES WHITE,
Cambridge St., Glasgow.



THE CAMBRIDGE SCIENTIFIC INSTRUMENT CO., Ltd., CAMBRIDGE.

NEW ROCKING MICROTOME. 1900 PATTERN. [PATENTED.]

This Instrument possesses the following great improvements over the old type of instruments:—
(1) Increased rigidity. (2) The impossibility of cutting thin and thick sections. (3) The impossibility of tearing sections on the upward movement of the object. (4) A graduated arc for showing the thickness of the sections. (5) Catch for holding the object above the edge of the razor. (6) Improved method of fixing the cord. (7) A new object holder.

PRICE (including object holder), £5 0 0
Write for Pamphlet descriptive of the above Instrument.

Address all communications:—
INSTRUMENT COMPANY, CAMBRIDGE.

"NIVOC" SPECIALITIES.

WORKS—BIRMINGHAM.

Buy direct from the Manufacturers.



DIAL RESISTANCE BOX, 20/-.
Reads from 1 ohm to 99.9 ohms, or from 1 ohm to 999 ohms as desired.



RINTOUL'S SPRING DYNAMOMETER, 2/6.



BOYLE'S LAW APPARATUS, 45/-.

SCHOOL WORLD (Dec. '99) says:—"Messrs. W. and J. George, Ltd., have a large number of novelties with which the teacher of practical physics should make himself acquainted."

COMPLETE LABORATORY FURNISHERS AND MANUFACTURERS
OF CHEMICAL, PHYSICAL, AND BACTERIOLOGICAL APPARATUS,
INCLUDING THE CELEBRATED "NIVOC" SPECIALITIES.

CATALOGUES ON APPLICATION

W. & J. GEORGE, LTD., 33-37 HATTON WALL, LONDON.
(Late F. E. BECKER & CO.)

DINES' PATENT PRESSURE PORTABLE ANEMOMETER.



For many years the want has been felt of a PORTABLE ANEMOMETER, by means of which the actual Velocity and Pressure of the Wind could be quickly ascertained. This want Mr. W. DINES, who is well known for his anemometrical experiments, has met by his PATENT PRESSURE PORTABLE ANEMOMETER.

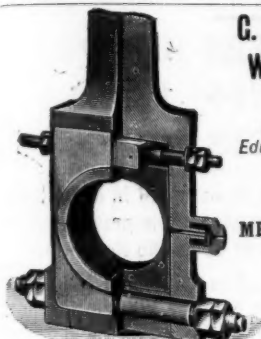
One scale of the instrument shows *directly* the actual velocity of the wind; the other (not shown in the woodcut) the pressure exerted in pounds per square foot. The instrument is used vertically, with the nozzle pointing towards the wind.

FULL PARTICULARS SENT ON APPLICATION.

PRICE ... £3 10 0

L. CASELLA,

SCIENTIFIC INSTRUMENT MAKER TO THE ADMIRALTY AND ORDNANCE,
Telegraphic Address "SCOUTHORN, LONDON." 147 HOLBORN BARS, LONDON, E.C. Telephone, "1004 Holborn."



MACHINE DRAWING.

PHYSICAL APPARATUS (Owens College Set).

**G. CUSSONS, TECHNICAL
WORKS, MANCHESTER,
N.W.**

See Exhibits at the English
Education Exhibition, Imperial
Institute, London.

APPARATUS FOR
MECHANICS, ENGINEERING
AND BUILDING.

CUSSONS' NEW
PATENT ATWOOD
MACHINE.

W. G. PYE & CO.
Physical & Physiological Instrument Makers,

"GRANTA" WORKS,

MILL LANE, CAMBRIDGE

(Late 30 ST. ANDREW'S STREET, CAMBRIDGE).

CHEAP AND EFFICIENT APPARATUS FOR
SCIENCE SCHOOLS A SPECIALITY.

Reliable Apparatus at low prices for teaching Mechanics, Hydrostatics, Heat, Optics, Magnetism, Physiology and Electricity, as supplied to many of the leading Technical Institutes and Organised Science Schools.

CATALOGUES ON APPLICATION AND CORRESPONDENCE
INVITED.

NEW SCIENCE LANTERN.

SOLE MAKERS:
REYNOLDS & BRANSON,
Ltd.

IMPROVED
PORTABLE
DESIGN.



The Universal Science Lantern has been devised for the projection of experiments. In the short box in front of the lantern is a hinged mirror, so placed that by the movement of a stud it may be introduced and placed at an angle of 45 degrees with the parallel beam. The beam is thus sent upwards through a horizontal convergent lens, on which a slide or horizontal piece of apparatus can be placed. Above this is the objective mounted on a brass pillar, and above the objective a prism or mirror (if the screen is elevated above the lantern plain prisms are required for each beam), silvered on the outside so that there is no double reflection. The mirror can be adjusted to any angle, and is intended to send the image in an approximately horizontal direction to the screen. Slides can also be directly projected in the usual way.

The base-board is made to fold so that the lantern can be packed into a box 18½ x 8½ x 5½ with all its accessories *in situ*.

Price Complete, in Travelling Box, £9 0 0

REYNOLDS & BRANSON, LTD.
14 COMMERCIAL STREET, LEEDS.

OBSERVATIONS AND - - - SCIENTIFIC INVESTIGATIONS

Can be performed easily
and quickly, and impor-
tant facts and deductions
neatly and legibly re-
corded, with the aid of a
Writing Machine. The
one that will enable the
Scientist to obtain the
best results, and give
him the greatest satisfac-
tion, is undoubtedly that
Marvel of Mechanical
Skill,



THE
YOST
TYPE-
WRITER.

For full particulars of this wonderful Instrument, send
for Illustrated "E" Catalogue to

The YOST TYPEWRITER Co., Ltd.,
50 HOLBORN VIADUCT,
London, E.C.

WEST END DEPOT:—303 Oxford Street.

NOTICE.—The attention of the readers of this Journal is called to the

NATURE RE-ISSUE

OF THE

INTERNATIONAL SCIENTIFIC SERIES.

EIGHTY-SIX VOLUMES.

**A COMPLETE LIBRARY OF SCIENCE AT
A GREATLY REDUCED PRICE.**

PUBLISHERS' PRICE	...	...	...	...	£21 10 0
BY INSTALMENT (TO-DAY)	...	...	...	...	£14 14 0
FOR CASH	...	...	...	...	£13 10 0

The "International Scientific Series" has a world-wide reputation, and is to be found in every well-equipped Library throughout the English-speaking world. No more generous or acceptable present could be made to any Public Library or individual than this magnificent Encyclopædia of Scientific Research.

Most of the works are illustrated, and many with beautiful coloured plates. The Series has been contributed to by men of science of the highest eminence, such as Tyndall, Herbert Spencer, Walter Bagehot, Alexander Bain, Stanley Jevons, Huxley, Sir John Lubbock, G. J. Romanes, Balfour Stewart, Sir Norman Lockyer, Draper, Bonney, Sir Hubert Parry, Sir E. Maunde Thompson. This list only professes to convey a slight idea of the attention that has been given to the whole Series by the selection of only the best writers to deal with the various subjects considered.

This special offer is open only for a short time, and intending purchasers will do well therefore to send their orders without delay.

For the benefit of those who do not feel disposed to buy the entire Series, it will be possible to secure half the Series, making 43 volumes, for £7 cash, or £7 7s. on the instalment system. The whole Series or half, as the case may be, will be sent on receipt of the first payment of One Guinea—the rest to be paid at the rate of £1 1s. per month.

**NOTE:—OFFER OPEN ONLY FOR A SHORT TIME.
ORDER AT ONCE.**

A Set of the Volumes may be seen at the Office of NATURE, ST. MARTIN'S STREET, W.C.

A Pamphlet, giving titles, &c., of the Works in the Series, Specimen Pages, with Illustrations, of some of the Volumes, also Order Form, will be sent Post Free on application to

C. WORSFOLD, "NATURE" Office, St. Martin's Street, London, W.C.

ORDER FORM.

Date.....1900.

All cheques should be crossed and made payable to C. WORSFOLD, "NATURE" Office, St. Martin's Street, W.C.

I enclose One Guinea as first payment for "NATURE's Re-issue of the International Scientific Series," and I agree to pay to you, or your representative, the balance at the rate of One Guinea per month; my next payment to be on delivery of the volumes, and my remaining payments on the corresponding day of each month following.

Until such payments are complete, I engage that the Works, not being my property, shall not be disposed of by sale or otherwise.

I further agree that if it be found impossible for any reason to deliver the books, the return of the sum of One Guinea to me shall cancel this agreement.

Name.....

Address.....

Residents abroad are kindly requested to remit in full, or to instruct their representatives in England to make the monthly payments, in order to avoid the expense and delay in forwarding cash from abroad.

CARL ZEISS,

MANUFACTURER OF

MICROSCOPES; TELESCOPES (ASTRONOMICAL and TERRESTRIAL); PRISM FIELD GLASSES; TELEMETERS; PHOTOGRAPHIC OBJECTIVES; and OPTICAL MEASURING INSTRUMENTS, including COMPARATORS, REFRACTOMETERS, BUTTER-REFRACTOMETERS, SPECTROMETERS, &c.

LONDON BRANCH:

29 MARGARET ST., CAVENDISH SQUARE, W.

Telegrams:—DIACINIC, London.

CATALOGUES POST FREE. KINDLY SAY WHICH REQUIRED.

SPECTROSCOPES.

FOR:—

GENERAL EXPERIMENTAL WORK.

ABSORPTION WORK.

CHEMICAL ANALYSIS.

ULTRA-VIOLET WORK (with Complete Quartz Train)

SPECTRAL PHOTOGRAPHY.

ZEEMAN EFFECT OBSERVATIONS by aid of

MICHELSON'S ECHELON GRATING.

MICROSCOPIC WORK.

CAMERAS ADAPTED TO ANY SPECTROSCOPE.

Spectroscopes Designed for any purpose.

PRICE LIST OF SPECTROSCOPES SENT ON APPLICATION.

ADAM HILGER, 204 Stanhope St., London, N.W.

**T. TAMBLYN-WATTS,
SCIENTIFIC APPARATUS MAKER.**

Catalogue of Electrical Apparatus and Materials, 6d. Post free.

Catalogue of Balances and Weights, Apparatus for the Study of Mechanics, &c., 6d. Post free.

GOLDIELANDS, SETTLE, YORKS.

SECOND-HAND MICROSCOPESBy SWIFT, WATSON, CROUCH, BECK, ZEISS, LEITZ, &c.
Prices from £2 10s. to £45.

A Large Selection of Second-hand Powers and Fittings for all kinds of Microscopes.

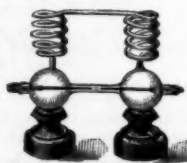
Send for New List.

CLARKSON & CO., 28 Bartlett's Buildings, Holborn Circus, E.C.

GLASS BLOWING.

All kinds of Experimental Glass Blowing carried out for Scientific Men, Laboratories, &c.

INVENTORS' IDEAS WORKED OUT AS PER INSTRUCTIONS.

COSSOR,
67 Farringdon Road, E.C.

Hittorf's Tube showing the resistance of the dark space.

ALBERT EDWARD JAMRACH
(Late CHARLES JAMRACH),
NATURALIST,

180 ST. GEORGE STREET EAST.

Implements of Savage Warfare, Idols, Sacred Masks, Peruvian Pottery, Netsukis China, Lacquers, Gongs, Shells, and other Curios.

**THE SCIENTIFIC ROLL
AND MAGAZINE OF SYSTEMATIZED NOTES.**

THIS WORK IS A VALUABLE
GUIDE, BIBLIOGRAPHY, AND INDEX TO SCIENCE.

*In preparation.***BACTERIA (Botanical Section).**

Although these are the simplest of plants, there is probably no group of organisms which exceeds them in interest or importance. Their operations affect the welfare of every member of the community, as also of the whole organic world. A full knowledge of them is essential in all questions bearing upon public and private health, agriculture, the microbial diseases of animals and of plants; and it is important in many industries, such as those dealing with milk, butter, hay, flax, tobacco, and others.

The group will be dealt with in three octavo volumes of about 500 pp. each. The subscription price will be 10s. for each volume, payable on delivery of the first number of the volume; or arrangements may be made to supply only the portions relating to a particular species, genus, or topic, at a proportionately reduced rate. The first volume will be commenced next summer, and if sufficient subscribers support the work, the three volumes will be completed in three years. As all the matter will be systematized, the series will be equivalent to a good bacteriological library, with the advantage that the information on any particular point will be comprised within a comparatively few pages, and not scattered over thousands of pages in a host of journals and books.

The names and addresses of subscribers, and applications for prospectus may be sent to the undersigned.

The undersigned will be glad to hear from PRINTERS willing to give estimates for printing, and from PUBLISHERS willing to consider terms for publishing the above-mentioned work.

A. RAMSAY,
4 Cowper Road, Acton, London, W.

WATKINS & DONCASTER,NATURALISTS,
AND MANUFACTURERS OF**CABINETS AND APPARATUS**FOR ENTOMOLOGY, BIRDS' EGGS, AND ALL BRANCHES OF
NATURAL HISTORY.

SPECIAL SHOW-ROOM FOR CABINETS.

Call or send for detailed Catalogue (66 pp.), Post free on application.

N.B.—For Excellence and Superiority of Cabinets and Apparatus, references are permitted to distinguished patrons, Museums, Colleges, &c.

A LARGE STOCK OF INSECTS AND BIRDS' EGGS

Birds, Mammals, &c., Preserved and Mounted by First-class Workmen with true natural surroundings. All Books and Publications on Natural History supplied.

36 STRAND, LONDON, W.C.
(Five Doors from Charing Cross.)

**LIVING SPECIMENS FOR
THE MICROSCOPE.**

Volvox, Spirogyra, Desmids, Diatoms, Amoeba, Arcella, Actinosphaerium Vorticella, Stentor, Hydra, Filicula, Stephanoceros, Melicerta, and many other Specimens of Pond Life. Price 1s. per Tube, Post Free. Helix pomatia, Astacus, Amphioxus, Rana, Anodon, &c., for Dissection purposes.

THOMAS BOLTON,

25 BALSALL HEATH ROAD, BIRMINGHAM.

**MARINE BIOLOGICAL ASSOCIATION
OF THE UNITED KINGDOM.**

THE LABORATORY, PLYMOUTH.

The following animals can always be supplied, either living or preserved by the best methods:—

Sycon; Clava, Obelia, Sertularia; Actinia, Tealia, Caryophyllia, Alcyonium; Hormiphora (preserved); Leptoplana; Lineus, Amphiporus; Nereis, Aphrodite, Arenicola, Lanice, Terebella; Lepas, Balanus, Gammarus, Ligia, Mysid, Nebalia, Carcinus; Patella, Buccinum, Eledone, Pecten, Bugula, Crisia, Pedicellina, Holothuria, Asterias, Echinus; Ascidia, Salpa (preserved), Scyllium, Raja, &c., &c.

For prices and more detailed lists apply to
Biological Laboratory, Plymouth.

THE DIRECTOR.

BORD'S PIANOS

25 per cent. Discount for Cash, or 14/6 per month (second-hand, 10/6 per month) on the Three Years' System. Lists free of
C. STILES & CO., 40 & 42 Southampton Row, London, W.C.
PIANOS EXCHANGED.

BECHSTEIN PIANOS

These magnificent Pianos for Hire on the Three Years' System at advantageous prices and terms. Lists and particulars free of
CHAS. STILES & CO., 40 & 42 Southampton Row, LONDON, W.C.

**PHYSIOGRAPHY and GEOLOGY.
COLLECTIONS & MICROSCOPIC SLIDES,**

As advised by Science and Art Directory, arranged by
JAMES R. GREGORY & CO.,
Mineralogists, &c.,

To Science and Art Department, British, Indian and Colonial
Museums, &c.

**NOVELTIES and RARE GEMS and PRECIOUS
STONES.**

*Mineral Specimens for Museums, and Collectors, and all purposes.
Rock Specimens and Microscopic Sections of Rocks and Minerals
cut to order.*

NEW AND VALUABLE MINERAL SPECIMENS CONSTANTLY
ARRIVING.

Stores & Offices: 1 Kelso Place, KENSINGTON, W.
NEW CATALOGUES AND LISTS FREE.

MINERALS AND PRECIOUS STONES.

MR. HENSON has now on hand a Fine Series of interesting Sapphires,
also Topazes, Gold, and Barytes in Large Crystals of various Colours.
Large and perfectly clear Rock Crystal Balls, precious Opal Cameos,
Fluor Spar, Agate, Jasper, and other Stones cut for ornamental purposes.

LESSONS GIVEN,

SAMUEL HENSON,
97 REGENT STREET, LONDON, W.
ESTABLISHED 1840.

ESTABLISHED 1851.
BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

INVESTED FUNDS

£10,000,000.

The BIRKBECK ALMANACK, with full particulars, post free.
FRANCIS RAVENSCROFT, Manager.

THE MOST NUTRITIOUS.

E P P S'S
GRATEFUL—COMFORTING.
C O C O A
BREAKFAST—SUPPER.

NOTICE.—Advertisements and business letters for NATURE should be addressed to the Publishers; Editorial communications to the Editor. The telegraphic address of NATURE is "PHUSIS," LONDON.

SUBSCRIPTIONS TO "NATURE."

	£	s.	d.
Yearly	1	8	0
Half-yearly	0	14	6
Quarterly	0	7	6
TO ALL PLACES ABROAD:—			
Yearly	1	10	6
Half-yearly	0	15	5
Quarterly	0	8	0

Cheques and Money Orders payable to **MACMILLAN & CO., Limited.**
OFFICE: ST. MARTIN'S STREET, LONDON W.C.

**TO SCIENCE LECTURERS.
HUGHES' MOTO-PHOTOSCOPE FOR LIVING PICTURES.**

THE MOST PERFECT.

No SHUTTER, therefore no Flickering. Superb Mechanism.
The Moto-Photo Camera for taking the Pictures. Illustrated Lists, 2d.
See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN, &c. Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great success. New Oxyhydrogen Microscope. Science Lanterns for Class Demonstration. Magnificent Results. Docwra Triple, Prize Medal, Highest Award. Supplied to the Royal Polytechnic Institution, Dr. H. GRATTAN GUINNESS, Madame ADELINA PATTI, &c. Patent Pamphengos Science Lanterns. The Universal Lantern 4-inch Condensers 4-wick Lamp, Portrait Combination front Lenses, 18s. 6d., Marvellous value. Science Lecture Sets. Novelties. The Lantern Kaleidoscope. Cheapest Lantern Outfits in the World. Grandly Illustrated Catalogue, over 180 choice Engravings, 6d.; Postage, 3d. List of 300 Lecture Sets; Science Subjects, Views, &c., 6d.; Postage 2d. Pamphlets Free. W. C. HUGHES, SPECIALIST, Brewster House, 82 Mortimer Road, Kingsland, N.

MINERALS, ROCKS & FOSSILS.

COLLECTIONS FOR STUDENTS.

Carefully labelled and arranged in Boxes with Card Trays.

50 Minerals, 12/6; 100 do., 21/; 200 do., 42/.

Rocks and Fossils at similar prices.

300 Minerals in Cabinet, £4 4s.; 400 do., £5 12s. 6d.

Catalogues Post Free.

THOMAS D. RUSSELL,
78 NEWGATE STREET, LONDON, E.C.

**HOLLOWAY'S OINTMENT
CURES**

Gout, Rheumatism, Lumbago, Sciatica, Cuts
Bruises, Sprains, &c.

INVALUABLE FOR ALL SKIN DISEASES.

Holloway's Ointment and Pills may be obtained of
all Medicine Vendors.

THE IRISH NATURALIST.
A Monthly Magazine of Irish Zoology, Botany, and
Geology. Price 8d.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD
PRAEGER, B.A.

Annual Subscription, 5s. Post Free to any Address.

Dublin: KASON & SON, LTD., 40 Lower Sackville Street
(to which Address Subscriptions should be sent).

London: SIMPKIN, MARSHALL, HAMILTON, KENT, & CO., Ltd.

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
*Three Lines in Column	0	2	6
Per Line after	0	0	9
One Eighth Page, or Quarter Column	0	18	6
Quarter Page, or Half a Column	1	15	0
Half a Page, or a Column	3	5	0
Whole Page	6	6	0

* The first line being in heavy type is charged for as Two Lines

MACMILLAN & CO.'S NEW BOOKS.

JUST PUBLISHED.

A MANUAL OF ZOOLOGY.

By the late Prof. T. J. PARKER, D.Sc., F.R.S., and Prof. W. A. HASWELL, M.A., D.Sc., F.R.S.

With Three Hundred Illustrations. Crown 8vo, 10s. 6d.

SPECTATOR.—"The illustrations are excellent, one might almost say nearly perfect, and the volume generally needs no praise."

TEXT-BOOK OF PALÆONTOLOGY. By KARL A. VON ZITTEL, Professor of Geology and Palæontology in the University of Munich. Translated and Edited by CHAS. R. EASTMAN, Ph.D., Assistant in Palæontology in the Museum of Comparative Zoology at Harvard. With 1476 Woodcuts. Medium 8vo, 25s. net. [Ready on Tuesday.]

* * This English Edition is revised and enlarged by the Author and Editor in collaboration with numerous Specialists.

THE PRINCIPLES OF MECHANICS PRESENTED IN A NEW FORM.

By HEINRICH HERTZ, late Professor of Physics in the University of Bonn. With an Introduction by H. VON HELMHOLTZ. Authorised English Translation by D. E. JONES, B.Sc., District Inspector under the Department of Science and Art, &c., and J. T. WALLEY, M.A. 8vo, 10s. net.

VOLUME III. (COMPLETING THE WORK) READY ON TUESDAY.

DICTIONARY OF POLITICAL ECONOMY.

Edited by R. H. INGLIS PALGRAVE.

Vol. III. (completing the work). Medium 8vo, 21s. net. (Also Ready, Vols. I. and II., 21s. net each.)

ECONOMIC REVIEW.—"The editor has certainly deserved well of the community; he has produced a book which will be widely appreciated by all sorts and conditions of men, not only by the student of economics, but by the man of business and the 'ordinary person.'"

ECONOMIC JOURNAL.—"Its value is manifest: ample and trustworthy information, abundance of verified documents, bibliography of inappreciable value, it must be the *vade mecum* of him who wishes more knowledge."

NOTES ON SPORT AND TRAVEL.

By GEORGE HENRY KINGSLEY, M.D.

With a Memoir by his Daughter, MARY H. KINGSLEY. With Portrait. Extra Crown 8vo, 8s. 6d. net.

DAILY NEWS.—"It can be said without flattery that a book of reminiscences by one of the Kingsley brothers, with a memoir of the author by his daughter, of West African renown, cannot be otherwise than delightful."

INTRODUCTION TO PHYSICAL CHEMISTRY.

By JAMES WALKER, D.Sc.,

Ph.D., Professor of Chemistry in University College, Dundee. 8vo, 10s. net.

LANCET.—"The book is written in such a lucid way as to render its perusal free from that irksomeness which is so often the student's experience when confronted with theoretical considerations. The book should serve as an admirable introduction to more advanced works."

FEBRUARY NUMBER NOW READY.

THE SCHOOL WORLD.

A MONTHLY MAGAZINE OF EDUCATIONAL WORK AND PROGRESS.

PRICE SIXPENCE. ANNUAL SUBSCRIPTION, POST FREE, EIGHT SHILLINGS NET.

CONTENTS.

The Parent and the Secondary School. A Practical Contribution to the Problem. By J. J. Findlay.—**Set Books in French for the Oxford Local Examination in July, 1900.** Set Books *versus* Unseen Translation. By Prof. Walter Rippmann, M.A.—**Pioneers in Education.** II.: Some Practical Views on Education of John Dury (in the age of Cromwell). By Prof. Foster Watson, M.A.—**Leisure-hour Pursuits in Boarding Schools.** By Frederick Andrews, B.A.—**Noughts and Crosses.** (Illustrated.) By Prof. G. B. Mathews, M.A.—**Experimental Chemistry.** (Illustrated.) I.: Chemical and Physical Change. Mixtures, Compounds and Elements. Indestructibility of Matter. By Prof. J. B. Coleman, A.R.C.S., F.I.C.—**The Teaching of English in Public Schools.** By Rev. G. C. Bell, M.A.—**The Teaching of Botany in Schools.** By Prof. L. C. Miall, F.R.S.—**The Syllabus and Examinations in the Theory of Teaching,** with suggestions for their Amendment. By Prof. James Welton, M.A.—Examination Paper in the Theory of Teaching.—Teachers' Notes on English History, 1603-1715. IV.: The Commonwealth, 1649-1660. By C. S. Fearenside, M.A., and L. J. McNair, B.A.—Current Geographical Topics. The Boundary Changes of 1899 affecting Britain. By Dr. A. J. Herbertson, F.R.G.S.—**The Resolutions of Recent Conferences.**—Items of Interest: General; Scotch; Welsh; Irish; Foreign; Current History.—Floreat Etona—Esto Perpetua. (Illustrated).—On the Geography of Europe. (Illustrated).—Reviews of Recent School Books. (Illustrated).—London Matriculation, June, 1900. Monthly Test Papers, No. 2.—Junior Oxford Local Examination, July, 1900. Monthly Test Papers, No. 2.—Preliminary Oxford Local Examination, July, 1900. Monthly Test Papers, No. 2.—Correspondence: The Sallèze Method of Teaching History. By Miss Dorothea Beale and Ethel M. Reilly. Apparatus for Determining "g." By W. R. S. The Quantitative Shibboleth. By Dr. Bevan Lean, B.A.—A Teacher's Library of Geography. By C. S. Fearenside, M.A., and Dr. Hugh Robert Mill. "Origin of Brushwork" at the English Education Exhibition. By Ebenezer Cooke.—Prize Competition. Result of No. 9. Competition No. 10.—Our Chess Column.—Calendar.

* * Also Ready, Volume I., containing Nos. I.-XII., January to December 1899, Demy 4to, 480 pp. Index.

Price 7s. 6d. net. Cloth Cases for binding Vol. I. are also ready, price 1s. net.

MACMILLAN & CO., LIMITED, LONDON.

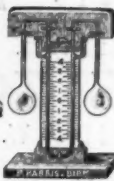


HARRIS'S ORIGINAL PATTERN ATWOOD MACHINE, forza, Accurate and Reliable, 8 to 9 feet high, Gratiuated, £3 15s.

HARRIS'S SPECIALITIES.—CATALOGUES UPON APPLICATION.



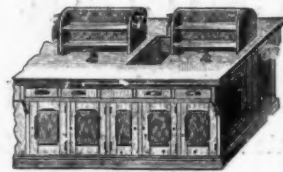
Vernier Microscope, 196A, £2 25. 6d.



Registered Differential Thermometer, 6287A, 15s. 6d.



New Cathetometer, 187C, £5 14. 6d.



Complete Laboratory Furnishing.



Drawing Model

ESTIMATES FREE.

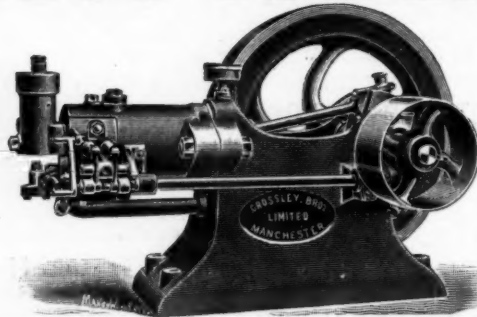
PHILIP HARRIS & Co., Ltd.,

Telegraphic Address: "Science," Birmingham. Telephone No. 10.

COMPLETE LABORATORY FURNISHERS, BIRMINGHAM.

CROSSLEY'S GAS ENGINES.

RECENTLY
REMODELLED.



GREAT
REDUCTION
IN
GAS
CONSUMED.

CROSSLEY BROS., LTD., OPENSHAW, MANCHESTER.

WATSON'S NEW MICROSCOPES AND APPARATUS.



WATSON'S HOLOSCOPIC EYEPIECES, for use with either APOCHROMATIC or ACHROMATIC OBJECTIVES, an adjustment being provided to the special lenses employed, for altering the correction. There is no sacrifice of efficiency, the performance being equal to the most expensive Compensating or Huyghenian Oculars.

Magnifying Powers—

6 in. tube length, 5, 7, 10, and 14 diameters. 10 in. " 7, 10, 14, and 20 "

PRICE, in Student's Size and Pattern, either power, 17/6 each.

For Full Particulars see Supplemental List, Post Free.

W. WATSON & SONS (Established 1837), Opticians to H.M. Government.

313 HIGH HOLBORN, LONDON, W.C. New Branch Now Open: 16 FORREST ROAD, EDINBURGH. And at 78 Swanston Street, Melbourne, Australia. Awarded 39 Gold and other Medals at the principal International Exhibitions of the World.

WATSON'S Parachromatic OIL IMMERSION CONDENSER.

Total aperture, 1.30; applanatic aperture exceeds 1.25. Undoubtedly the finest Condenser obtainable for high-power work. Optical part only ... £5 0 0

Completely mounted with Iris Diaphragm and Set of Stops ... £6 10 0

WATSON'S "SCHOOL" MICROSCOPE, New Model, complete with 1 in. Objective, in Case ... £3 3 0

WATSON'S "ROYAL" MICROSCOPE. A new model high-class instrument.

WATSON'S "FRAM" MICROSCOPE. A highest-class instrument at a very moderate cost.

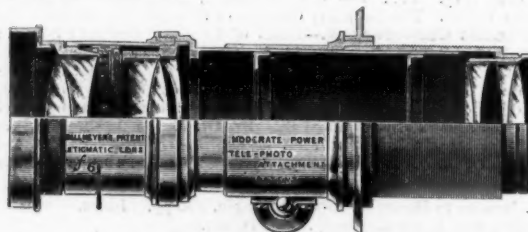
BACTERIOLOGICAL APPARATUS. MICROTOMES. Apparatus for FIELD BOTANY and FIELD GEOLOGY. METAMORPHOSES and DISSECTED PREPARATIONS. BOTANICAL and PHYSIOLOGICAL MODELS.

For Particulars of all the above, see

Watson's New Supplemental List to Catalogue No. 2, Post Free on application.

Watson's Catalogue (No. 3) is a Classified List representing a Stock of 40,000 first-class Micro-Slides, Post free on application.

DALLMEYER'S TELE-PHOTO. LENSES & ATTACHMENTS



Stigmatic Lens fitted with Tele-Photo. Attachment.
(These Attachments can be fitted to any good Lens.)

Enable you to take Photographs of Distant or Inaccessible Subjects of sufficient size to be of practical value.

Indispensable to Geologists, Naturalists, and Architects.

Price from £3 15s.

Prices and Particulars on application. Estimates and advice free.

J. H. DALLMEYER, Ltd.,
25 Newman Street, London, W.



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

No. 1579, VOL. 61]

THURSDAY, FEBRUARY 1, 1900.

[PRICE SIXPENCE.

Registered as a Newspaper at the General Post Office.]

[All Rights are Reserved.

WIRELESS TELEGRAPHY.

The "APPS-NEWTON" INDUCTION COILS have proved far superior to all others in telegraphing long distances without wires.

They were used in the Government Experiments at Penarth and Dover; also by Signor Marconi and the Wireless Telegraph Company in telegraphing to and from the Goodwin Lightship, and across the Channel; at the British Association Meeting at Dover for telegraphing to France; and at the Naval Manœuvres, where a distance of sixty miles was covered, &c.

After prolonged tests the "Apps-Newton" Coils have been adopted by the Wireless Telegraph Company, by the War Office and by the Admiralty; several have been sent to the Front in South Africa, and the ships of the Channel Squadron are now being fitted with them.

PRICES ON APPLICATION.

SOLE MAKERS:

NEWTON & CO.,

Scientific Instrument Makers to H.M. the Queen and the Government.

3 FLEET STREET, LONDON, E.C.

GRIFFIN'S NEW FORM OF APPARATUS
For the ABSOLUTE

EXPANSION OF SOLIDS

(Wooden's Patent).



One great merit in the design of this Apparatus is that it is a purely Mechanical method, and does not depend at all upon Optical methods of magnification that so frequently are a difficulty in early Practical Physics work. The measurement reduces itself to the readings of two Micrometer Screws.

A DIRECT MECHANICAL METHOD.

ABSOLUTE READINGS OBTAINED.

SIMPLEST DESIGN.

Write for Particulars, and Specimen Curves obtained.

SOLE MAKERS:

JOHN J. GRIFFIN & SONS, L^d
20-26 SARDINIA STREET, LONDON, W.C.

THE PROGRESSIVE SCIENCE SERIES.

READY NEXT WEEK.

A BOOK OF WHALES.

BY THE EDITOR OF THE SERIES,

F. E. BEDDARD, M.A., F.R.S.

With Forty Illustrations by SIDNEY BERRIDGE.

Large 8vo, Cloth extra, fully Illustrated, 6s.

The last Volume published was BACTERIA,
by George Newman, M.D., F.R.S.E., D.P.H.

A COMPLETE LIST OF THE ABOVE SERIES CAN BE
OBTAINED POST FREE ON APPLICATION.

JOHN MURRAY, ALBEMARLE STREET, W.

NEGRETTI & ZAMBRA'S

LONG RANGE BINOCULARS AND TELESCOPES

FOR MILITARY PURPOSES.

ILLUSTRATED PRICE LISTS FREE BY POST TO
ALL PARTS OF THE WORLD.

SPECIAL TERMS TO YEOMANRY TROOPS AND VOLUNTEER
CORPS REQUIRING SEVERAL GLASSES.



THE
"READY-FOCUS"
BINOCULAR.

A great
improvement over the ordinary system
of Focussing.
Invaluable in watching moving
objects.

NEGRETTI & ZAMBRA,

SCIENTIFIC INSTRUMENT MAKERS TO THE QUEEN,

38 HOLBORN VIADUCT, E.C.

BRANCHES: 45 CORNHILL; 122 REGENT STREET.

A Course of Four Popular and Instructive
LECTURES TO YOUNG PEOPLE
 Will be Delivered under the auspices of the Parents' National Educational Union, at the

HAMPSTEAD CONSERVATOIRE, SWISS COTTAGE, N.W.
 (Two minutes from Swiss Cottage Station),

On **MONDAYS, FEB. 5th, 12th, 19th and 26th**, at 5 p.m., entitled

"THE WONDERS OF CREATION,"

By **MR. CECIL CARUS-WILSON, F.R.S.E., &c.**

Fully illustrated by specially selected Photographic Lantern Slides, &c.

The Chair will be taken by **Rev. J. KIRKMAN, M.A., Vicar of St. Stephen's.**

Tickets for the Course of Four Lectures:—Children, 4s. 6d.; Adults, 5s. 6d.; one free Ticket being presented to each Teacher with every ten Pupils.

Full particulars and Tickets may be obtained from the Secretary of the P.N.E.U., 28 Victoria Street, Westminster, S.W.; Mrs. C. Herbert Smith, 19 Cannon Place, Hampstead; Miss Case, Winkworth Hall, Brondesbury; or Miss Etta Nauzen, 65 Clarendon Road, W.
 Doors open at 4.30. Carriages 6 o'clock.

ROYAL INSTITUTION OF GREAT BRITAIN.

ALBEMARLE STREET, PICCADILLY, W.

Prof. H. H. TURNER, M.A., F.R.S., Savilian Professor of Astronomy in the University of Oxford, will, on Thursday next, February 8, at Three o'clock, begin a Course of Three Lectures on "Modern Astronomy." Subscription to this Course, Half-a-Guinea; to all the Courses in the Season, Two Guineas.

ST. BARTHOLOMEW'S HOSPITAL AND COLLEGE.

PRELIMINARY SCIENTIFIC CLASS.

Systematic Courses of Lectures and Laboratory Work in the subjects of the Preliminary Scientific and Intermediate B.Sc. Examinations of the University of London are held throughout the year.

Attendance on this Class counts as part of the Five Years' Curriculum. Fee for the whole Course £21, or £18 to Students of the Hospital; or single Subjects may be taken.

For further particulars apply to the **WARDEN OF THE COLLEGE, St. Bartholomew's Hospital, London, E.C.**
 A Handbook forwarded on application.

MATRICULATION, HOSPITAL SCHOLARSHIPS, &c.

PREPARATION BY CORRESPONDENCE AND ORAL TUITION ON A THOROUGHLY INDIVIDUAL SYSTEM. Fees based on success. The **STAFF** includes Graduates of Oxford, Cambridge, London, and Royal Universities. Science Medalists, prizemen, Scholars, &c.
SINGLE SUBJECTS TAKEN: Latin, Greek, French, German, Mathematics, Science, Logic, Psychology, Political Economy, &c.
 For Terms, &c., address **Mr. J. CHARLESTON, B.A. (Lond. and Oxon.), The Burlington Classes, 27 Chancery Lane, London, W.C.**

QUERNMORE. LONDON BRANCH at 24 CHANCERY LANE, W.C.

Tuition by **JOHN GIBSON, M.A. (First Class, Camb.), and G. LOLY, B.A. (First Class, London)**, for all Public Examinations. **Special Instruction in Scientific Agriculture** for successful practical Agriculture and Forestry in the British Islands or the Colonies; also in **Chemistry, Physics, Geology, Botany, &c.** Practical Chemical and Physical Laboratories. The "State Correspondent" and Higher Examination Journal gives up-to-date particulars of all the leading C.S. and other Examinations. Price 5d., post free. Prize of One Guinea for competition each month; Special Prize of **Five Guineas** each June and December.

INSTRUCTION IN PURE CULTIVATION OF YEAST,

According to **HANSEN'S Methods.**

Courses for Beginners, as well as for Advanced Students, in Physiology and Technology of Fermentations—Biological Analysis of Yeast.

Manuals:—**E. Chr. Hansen:** "Practical Studies in Fermentation." London (Spon), 1896. **Alfred Jörgensen:** "Micro-organisms and Fermentation." London (F. W. Lyon), 1893.

Further Particulars on Application to the Director, **ALFRED JÖRGENSEN, The Laboratory, Copenhagen, V.**

SCIENCE EXAMINATIONS.

For **LONDON** and other **UNIVERSITIES**, the **CONJOINT BOARD, &c.**

Well-equipped **LABORATORIES, DAY AND EVENING.** Personal or Class Tuition.

"R.," 9 Heathcote Street, Gray's Inn Road, W.C.

MUNICIPAL SCIENCE, ART AND TECHNICAL SCHOOLS, PLYMOUTH.

WANTED, an ASSISTANT MASTER, mainly for Elementary Science Work. Must be qualified to give Manual Training in Wood and Metal Work. Whitworth Scholar preferred. Salary, £100; rising to £120.

Further particulars from **T. W. BYFIELD, Secretary.**

EAST LONDON TECHNICAL COLLEGE.

ASSISTANT DEMONSTRATOR is Required in the Day Physics Laboratory. Commencing Salary, £75. Applications should be addressed to the **TREASURER.**

CHEMIST and PHYSICIST, trained at a German Technical University, and late Assistant in Physical Department of same, seeks situation. Advertiser can undertake Construction of Instruments, also repair of Glass.—**E. PORTER, c/o NATURE Office.**

LETCHER & SONS (formerly Letcher Bros.), SCIENTIFIC INSTRUMENT MAKERS, 25 TURNPIKE LANE, HORNSEY, N.

BLOWPIPE CABINETS. SPECIALITY: SOCIETY OF ARTS SETS.

A NEW STEREOSCOPIC BINOCULAR FIELD GLASS

Of NEW FORM and CONSTRUCTION.

(English Patents, Nos. 5639 and 7942, 1894.)



Of handy size, with large field, brilliant definition, perfect achromatism, and very decided STEREOSCOPIC effect, and which, when once adjusted, are always ready for use.

Prices: £6 to £8.

For **NAVAL MEN and DEERSTALKERS, &c.** (we have made larger sizes for NIGHT and DAY USE, admitting more light, but of somewhat greater weight). Prices: Night, £10; Day, £11.

Illustrated Price List free.

CARL ZEISS (of JENA),

29 MARGARET STREET, REGENT STREET, LONDON, W.

JAS. SWIFT & SON, MANUFACTURING OPTICIANS.

SOLELY APPOINTED TO THE A.M. DEPT. WAR OFFICE, FOR THE SUPPLY OF MICROSCOPES.



Patent form of Student's Microscope, fitted with 2 1/2" and 1 1/2" Pan-Aplanatic Objectives, Iris Diaphragm and Oculars, in Case, from

£5 5s.

These Instruments we have supplied in numbers to the following Medical Schools, viz. St. Mary's, St. Bartholomew's, Guy's, Middlesex, London, and St. Thomas's.

Seven Gold Medals awarded for excellence of manufacture.

Catalogue on Application.

81 TOTTENHAM COURT ROAD, W.

COSSOR,

67

FARRINGTON RD.,

E.C.



Original Maker of "X" RAY TUBES in England.

FOCUS TUBES giving finest possible definition. **IMPROVED TUBE HOLDERS**, with arrangement for securing wires to avoid perforation of tube. All kinds of "X" Ray Apparatus, Mercury Pumps, Screens, Spark Gaps, &c. Applications for Price Lists invited.

BARGAINS IN SCIENTIFIC BOOKS.

CAMPBELL (D. H.), THE STRUCTURE AND DEVELOPMENT OF THE MOSSES AND FERNS (ARCHEGONIATÆ). By DOUGLAS HOUGHTON CAMPBELL, Ph.D. Fully illustrated. Medium 8vo. (Pub. 14s. net.) 4s. "Dr. Campbell's book is clearly written, well illustrated, is provided with an accurate bibliography and a copious index, so that it will take its place at once as a standard classic, and will, we think, retain that position for no inconsiderable period."—*Gardener's Chronicle*.

BATESON (W.), MATERIAL FOR THE STUDY OF VARIATION, treated with especial regard to Discontinuity in the Origin of Species. By WILLIAM BATESON, M.A., Fellow of St. John's College, Cambridge. 8vo, Cloth. (Pub. 21s. net.) 5s.

"The whole work must be carefully read by every serious student; and there can be no question of its great and permanent value as a contribution to our knowledge of a particular class of variations, and as a stimulus to further work in a department of knowledge which is too much neglected."—*Nature*.

HEADLEY (F. W.), THE STRUCTURE AND LIFE OF BIRDS. By F. W. HEADLEY, M.A., F.Z.S., Assistant Master in Haileybury College. With 78 Illustrations. Crown 8vo, Cloth. (Pub. 7s. 6d.) 1s. 6d.

"We know of no book, at any rate, no modern book, which covers precisely the ground of Mr. Headley's Manual; it strengthens decidedly a weak point in Ornithological literature, and this fact, coupled with the excellence of the illustrations, should ensure for it a wide circulation."—*Ibis*.

COUES (Prof. ELLIOTT), HANDBOOK OF FIELD AND GENERAL ORNITHOLOGY, a Manual of the Structure and Classification of Birds, with Instructions for Collecting and Preserving Specimens. Illustrated. Demy 8vo, Cloth. (Pub. 10s.) 2s. 6d.

The volume consists of two distinct parts:—PART I.—Field Ornithology contains the necessary Instructions for the Observation and Collection of Birds in the field, and for the Preparation and Preservation of Specimens for scientific study in the Cabinet. PART II.—General Ornithology is a technical Treatise of the Classification, the Zoological Characters, and the Anatomical Structure. CHAPTERS.—Implements for Collecting and their Use—Dogs—Suggestions and Directions for Field-work—Hygiene of Collectorship—Registration and Labelling—Instruments—Materials and Fixtures—How to make a Bird-skin—Collection of Nests and Eggs—Care of a Collection—Definition of Birds—Principles and Practice of Classification—Definitions and Descriptions of the Exterior Parts of Birds—An Introduction to the Anatomy of Birds.

Postage 3d. extra on one, or 6d. on four.

H. J. GLAISHER, New and Remainder Bookseller, 57 Wigmore Street, London, W.

Catalogues Post Free on application.



Are the long-time users of the

Smith Premier Typewriter,

those who from experience have learnt the merits, and who testify that its capacity for good work all the time is unequalled, and that repair bills are reduced to a minimum.

SEND FOR ART CATALOGUE.



The Smith Premier Typewriter Co.,
14 Gracechurch Street, London, E.C.

JUST OUT.

Demy 8vo, Uncut, Price 31s. 6d. net, by post 32s.

BRITISH DRAGONFLIES:

Being an Exhaustive Treatise on our Native Odonata; their Collection, Classification and Preservation.

By W. J. LUCAS, B.A., F.E.S.

Very fully illustrated with 27 Plates illustrating 39 Species, exquisitely printed in Colour, and numerous Black and White Engravings.

CRIES AND CALL NOTES OF WILD

BIRDS. A Popular description of the notes employed by our commoner British birds in their songs and calls. Illustrated by musical notation. By C. A. WITCHELL. 12s., by post 12s. 2d.

NATURALIST'S DIRECTORY for 1900.

Sixth year of issue. Invaluable to all Students and Collectors. 12s. 6d., by post 12s. 9d.

PRACTICAL TAXIDERMY. A Manual

of Instruction to the Amateur in Collecting, Preserving and Setting up Natural History Specimens of all kinds. By M. BROWNE, F.Z.S. 2nd Edition. 7s. 6d., by post 7s. 10d.

BOOK OF BRITISH HAWK MOTHS.

A Popular and Practical Manual for all Lepidopterists. Copiously illustrated from the Author's own exquisite drawings. By W. J. LUCAS, B.A. 3s. 6d., by post 3s. 9d.

VIVARIUM. Snakes, Lizards, and other

Reptiles, and How to Keep them in Confinement. By Rev. G. C. BATEMAN. Illustrated. 7s. 6d. net, by post 8s.

Full Catalogue on Application.

London: L. UPCOTT GILL, 170 Strand, W.C.

THE SCIENTIFIC ROLL AND MAGAZINE OF SYSTEMATIZED NOTES.

THIS WORK IS A VALUABLE GUIDE, BIBLIOGRAPHY, AND INDEX TO SCIENCE.

In preparation.

BACTERIA (Botanical Section).

Although these are the simplest of plants, there is probably no group of organisms which exceeds them in interest or importance. Their operations affect the welfare of every member of the community, as also of the whole organic world. A full knowledge of them is essential in all questions bearing upon public and private health, agriculture, the microbial diseases of animals and of plants; and it is important in many industries, such as those dealing with milk, butter, hay, flax, tobacco, and others.

The group will be dealt with in three octavo volumes of about 500 pp. each. The subscription price will be 10s. for each volume, payable on delivery of the first number of the volume; or arrangements may be made to supply only the portions relating to a particular species, genus, or topic, at a proportionately reduced rate. The first volume will be commenced next summer, and if sufficient subscribers support the work, the three volumes will be completed in three years. As all the matter will be systematized, the series will be equivalent to a good bacteriological library, with the advantage that the information on any particular point will be comprised within a comparatively few pages, and not scattered over thousands of pages in a host of journals and books.

The names and addresses of subscribers, and applications for prospectus may be sent to the undersigned.

The undersigned will be glad to hear from PRINTERS willing to give estimates for printing, and from PUBLISHERS willing to consider terms for publishing the above-mentioned work.

A. RAMSAY,
4 Cowper Road, Acton, London, W.

Just Published. Price 12s.; per Post, 12s. 4d.

THE VICTORIA UNIVERSITY CALENDAR FOR THE YEAR 1900.

London:
MACMILLAN & CO., LTD.

Manchester:
J. E. CORNISH.

NOW READY.

**LABORATORY NOTE BOOK
FOR CHEMICAL STUDENTS.**By **VIVIAN B. LEWES,**

PROFESSOR OF CHEMISTRY, ROYAL NAVAL COLLEGE, AND

J. S. S. BRAME,ASSISTANT EXAMINER IN CHEMISTRY, SCIENCE AND
ART DEPARTMENT.

INTERLEAVED THROUGHOUT WITH WRITING PAPER.

PRICE 4s.

This book has been compiled on lines differing from those followed with the majority of books on Practical Chemistry. It is generally admitted that the most valuable notes are those made by the student himself, and it is with this idea that the book has been prepared, a feature being the copious interleaving for the recording of results obtained, equations, &c.

The book is divided into three parts:—

I. General Manipulation. The Preparation and Properties of Gases, &c.

II. The Reactions of the Metallic and Acid Radicals in a concise form, together with Analytical Tables.

III. Simple Quantitative Experiments (including a few Special Subjects for Naval Officers, Engineers, and Mining Students).

The Note Book is designed to be a useful companion to most of the ordinary text-books on the subject, whilst a student who has worked through the experiments described cannot fail to have a sound knowledge of elementary Practical Chemistry. It is essentially a book for the laboratory bench.

**THE DISCHARGE OF ELECTRICITY
THROUGH GASES.**By Professor **J. J. THOMSON, F.R.S.**

Crown 8vo, 4s. 6d. net.

ARCHIBALD CONSTABLE & CO.,
2 WHITEHALL GARDENS, WESTMINSTER.**On the ELECTRICAL CONDUCTIVITY**

and MAGNETIC PERMEABILITY of various ALLOYS of IRON.

By **W. F. BARRETT, F.R.S.**; **W. BROWN, B.Sc.**; **R. A. HADFIELD, M.Inst.C.E.** With 8 Plates. 4to. Price Four Shillings.**On some NOVEL THERMO-ELECTRIC**PHENOMENA. By **W. F. BARRETT, F.R.S.**, Professor of Experimental Physics in the Royal College of Science for Ireland. 4to. With 1 Plate. Price One Shilling.Being the **SCIENTIFIC TRANSACTIONS** of the **ROYAL DUBLIN SOCIETY**, Volume VII. Series II. Parts IV. and V.**COLLEMBOLA FROM FRANZ-JOSEF
LAND.**(Collected by **Mr. W. S. BRUCE, 1856-97.**)**PANTOPODA from the ARCTIC SEAS.**(Dredged by **Mr. W. S. BRUCE, 1897-98.**)By **GEORGE H. CARPENTER, B.Sc.** (London), Assistant Naturalist in the Science and Art Museum, Dublin.Being **SCIENTIFIC PROCEEDINGS** of the **ROYAL DUBLIN SOCIETY**, Vol. IX. (New Series), Part III, Nos. 16 & 17. Price Sixpence complete.London: **WILLIAMS & NORGATE**, 14 Henrietta Street, W.C.**THE SCIENTIFIC ROLL
AND MAGAZINE OF SYSTEMATIZED NOTES.
METEOROLOGICAL SECTION.****CLIMATE: GENERAL.** 4s.**CLIMATE: AQUEOUS VAPOUR.** 6s.

[Reprinting.

CLIMATE: BARIC CONDITION. Present Subscription Price, 10s.

The last No. is in Press.

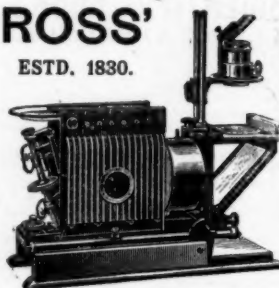
To be followed by

CARBONIC ACID, CHEMICAL RAYS, &c., to WIND.**O'DRISCOLL, LENN & CO.,** 10 and 12 Elephant Road, Elephant and Castle, London, S.E.

Medals and Highest Awards at all Great Exhibitions.

ROSS'

ESTD. 1830.

**ROSS' PATENT
NEW MODEL****PRISMATIC
BINOCULAR GLASS.**

"The power and field of a Telescope in the compass of an Opera Glass."

Combining Extreme Portability with High Power, Perfect Mechanical Construction, and Exquisite Definition.

**NEW SERIES
SCIENCE LANTERNS**
FOR SCHOOLS,
COLLEGES, & PRIVATE
EXHIBITIONS.

**PHOTOGRAPHIC LENSES
AND CAMERAS.****MICROSCOPES,
TELESCOPES, FIELD
GLASSES, &c. &c.****ROSS, Ltd., Manufacturing Opticians,**111 NEW BOND STREET, LONDON, W.,
And 31 COCKSPUR STREET, CHARING CROSS, S.W.**IMPROVED D'ARSONVAL
GALVANOMETERS.**

PRICES

£10-0-0

AND

£4-10-0

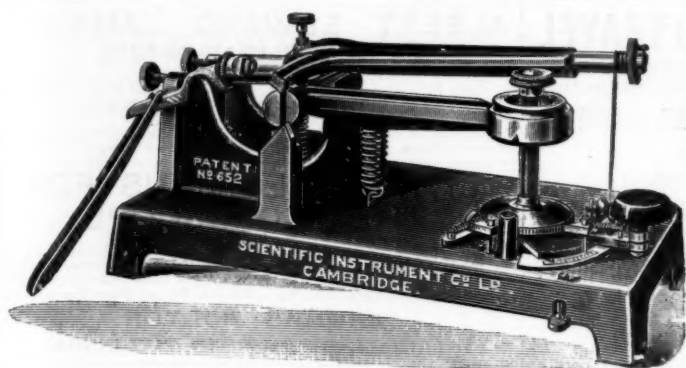
LIBERAL DISCOUNTS.



Most
SENSITIVE
for
DEFLECTIVE,
ZERO,
or
BALLISTIC
WORK.

Write for Price List and Particulars of Potentiometers, Galvanometers, Electrical Thermometers, Experimental Direct and Alternating Current Sets, &c., to

CROMPTON & CO., LD.,Laboratory { "THRIPLANDS," } LONDON, W.
KENSINGTON COURT,



THE CAMBRIDGE
SCIENTIFIC INSTRUMENT CO.,
Ltd., CAMBRIDGE.

NEW ROCKING MICROTOME.
1900 PATTERN. [PATENTED.]

This Instrument possesses the following great improvements over the old type of instruments:—
(1) Increased rigidity. (2) The impossibility of cutting thin and thick sections. (3) The impossibility of tearing sections on the upward movement of the object. (4) A graduated arc for showing the thickness of the sections. (5) Catch for holding the object above the edge of the razor. (6) Improved method of fixing the cord. (7) A new object holder.

PRICE (including object holder), £5 0 0

Write for Pamphlet descriptive of the above Instrument.

Address all communications to:—

INSTRUMENT COMPANY, CAMBRIDGE.

For Photography, Unsurpassed for fine definition.

COOKE LENSES

TAYLOR, TAYLOR, & HOBSON,
Stoughton Street Works, Leicester;
and 18 Berners Street, London, W.

PHŒNIX FIRE OFFICE,
19 LOMBARD ST., E.C., and 57 CHARING CROSS, S.W.
ESTABLISHED 1782.

MODERATE RATES. ABSOLUTE SECURITY.
ELECTRIC LIGHTING RULES SUPPLIED.

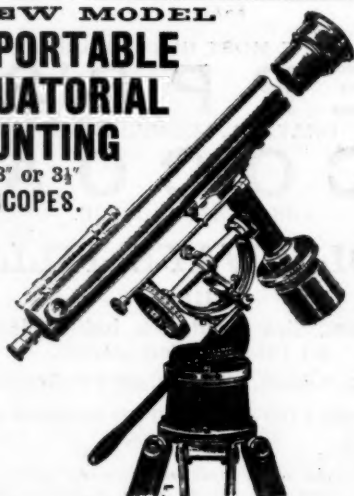
LIBERAL LOSS SETTLEMENTS.

PROMPT PAYMENT OF CLAIMS.

FRANCIS B. MACDONALD, SECRETARY.

LOSSES PAID OVER £22,000,000

NEW MODEL
**PORTABLE
EQUATORIAL
MOUNTING**
For 3" or 3½"
TELESCOPES.



Latitude Adjustment, Clamp for Declination Axis, Quick and Slow Motion, in Right Ascension.

EQUATORIAL MOUNTING with Divided Circles and Stand fitted with short Iron Column, Levelling Screws, and Metal Stretcher, £15 15s.; or, complete with 3" Telescope, £25.

ILLUSTRATED CATALOGUE GRATIS.

**J. H. STEWARD
OPTICIAN,**

406 STRAND, 457 WEST STRAND,
7 GRACECHURCH STREET, LONDON.

W. G. PYE & CO.
Physical & Physiological Instrument Makers,

"GRANTA" WORKS,
MILL LANE, CAMBRIDGE

(Late 30 ST. ANDREW'S STREET, CAMBRIDGE).

CHEAP AND EFFICIENT APPARATUS FOR
SCIENCE SCHOOLS A SPECIALITY.

Reliable Apparatus at low prices for teaching Mechanics, Hydrostatics, Heat, Optics, Magnetism, Physiology and Electricity, as supplied to many of the leading Technical Institutes and Organised Science Schools.

CATALOGUES ON APPLICATION AND CORRESPONDENCE INVITED.

C. E. MÜLLER & CO.,
SCIENTIFIC GLASS BLOWERS,
AND MANUFACTURERS OF

CHEMICAL & PHYSICAL APPARATUS,
X-Ray Tubes, Argon and Helium Spectrum Tubes,
Special Apparatus for Research, Chemical
Thermometers, &c., &c.



NEW
**GEISSLER
TUBES.**

The Flowers appearing in their Natural Colours under the Kathode Rays.

PRICE £1 : 1 : 0

AN ASSORTMENT KEPT IN STOCK.

PRICE LISTS OF CHEMICAL APPARATUS ON APPLICATION.

148 HIGH HOLBORN,
LONDON, W.C.

CO-OPERATIVE WORLD TRAVEL

Organised by HENRY S. LUNN, M.D., F.R.G.S.,
W. HOLDSWORTH LUNN & CONNOP F.S. PEROWNE.

A Cruise to GREECE, CONSTANTINOPLE, PALESTINE,
and EGYPT.

(Return Ticket to MARSEILLES included.)

A FORTY-TWO DAYS' CRUISE FOR £44 2s. AND UPWARDS.

s.v. ARGONAUT. Tonnage, 3254; h.-p., 4000.

£10 10s. and £13 13s. TOURS TO ROME.

Extensions to NAPLES, FLORENCE, VENICE,
and the ITALIAN LAKES.

Full particulars from the Secretary, 5 Endsleigh Gardens,
Euston, London, N.W.

THE IRISH NATURALIST.

A Monthly Magazine of Irish Zoology, Botany, and
Geology. Price 6d.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD
PRAEGER, B.A.

Annual Subscription, 5s. Post Free to any Address.
Dublin: EASON & SON, LTD., 40 Lower Sackville Street
(to which Address Subscriptions should be sent).

London: SIMPKIN, MARSHALL, HAMILTON, KENT, & CO., Ltd.

ESTABLISHED 1851.

BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

INVESTED FUNDS

£10,000,000.

The BIRKBECK ALMANACK, with full particulars, post free.

FRANCIS RAVENSCROFT, Manager.

THE MOST NUTRITIOUS.

E P P S'S

GRATEFUL—COMFORTING.

C O C O A

BREAKFAST—SUPPER.

HOLLOWAY'S PILLS

CURE

Billousness, Sick Headache, Indigestion, and
all Internal Complaints.

CAN BE TAKEN BY THE MOST DELICATE.

Holloway's Pills and Ointment may be obtained of
all Medicine Vendors.

NOTICE.—Advertisements and business letters for NATURE should be addressed to the Publishers; Editorial communications to the Editor. The telegraphic address of NATURE is "PHUSIS," LONDON.

SUBSCRIPTIONS TO "NATURE."

	£	s.	d.
Yearly	1	8	0
Half-yearly	0	14	6
Quarterly	0	7	6
TO ALL PLACES ABROAD:—			
Yearly	1	10	6
Half-yearly	0	15	5
Quarterly	0	8	0

Cheques and Money Orders payable to MACMILLAN & CO., Limited.
OFFICE: ST. MARTIN'S STREET, LONDON, W.C.

ALBERT EDWARD JAMRACH

(Late CHARLES JAMRACH),
NATURALIST,

180 ST. GEORGE STREET EAST.

Implements of Savage Warfare, Idols, Sacred Masks, Peruvian Pottery,
Netsukis China, Lacquers, Gongs, Shells, and other Curios.

LIVING SPECIMENS FOR THE MICROSCOPE.

Volvox, Spirogyra, Desmids, Diatoms, Amœba, Arcella, Actinosphaerium,
Vorticella, Stentor, Hydra, Floscularia, Stephanoceros, Melicerta, and many
other Specimens of Pond Life. Price 1s. per Tube, Post Free. Helix
pomatia, Astacus, Amphioxus, Rana, Anodon, &c., for Dissection purposes.

THOMAS BOLTON,

25 BALSALL HEATH ROAD, BIRMINGHAM.

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM.

THE LABORATORY, PLYMOUTH.

The following animals can always be supplied, either living
or preserved by the best methods:—

Sycon; Clava, Obelia, Sertularia; Actinia, Tealia, Caryophyllia, Alcy-
onium; Hormiphora (preserved); Leptoplana; Lineus, Amphiporus; Nereis,
Aphrodite, Arenicola, Lanic, Terebella; Lepas, Balanus, Gammarus,
Ligia, Mysid, Nebalia, Carcinus; Patella, Buccinum, Eledone, Pecten,
Bugaia, Crisia, Pedicellina, Holothuria, Asterias, Echinus; Ascidia, Salpa
(preserved), Scyllium, Raja, &c., &c.

For prices and more detailed lists apply to
Biological Laboratory, Plymouth.

THE DIRECTOR.

THE ENTOMOLOGIST:

AN ILLUSTRATED JOURNAL OF GENERAL ENTOMOLOGY.

Edited by RICHARD SOUTH, F.E.S.,

With the Assistance of

ROBERT ADKIN, F.E.S.

T. R. BILLUPS, F.E.S.

W. LUCAS DISTANT, F.E.S., &c.

EDWARD A. FITCH, F.L.S., F.E.S.

F. W. FROHAWK, F.E.S.

MARTIN JACOBY, F.E.S.

J. H. LEECH, B.A., F.L.S., F.E.S.

DR. D. SHARP, F.R.S., F.E.S., &c.

G. H. VERRALL, F.E.S.

W. WARREN, M.A., F.E.S.

W. F. KIRBY, F.E.S.

Founded by the late Edward Newman in 1840, this Journal has been
the popular organ of British Entomologists since 1864. Its contents deal
chiefly with the home fauna, but there are frequent articles and notes on
matters of interest pertaining to the Entomology of various parts of the world.

Published on the first of each month. Price 6d. Subscription, 6s. per
annum post free to any country.

London: WEST, NEWMAN, & CO., 54 Hatton Garden, E.C.

THE ENTOMOLOGISTS' MONTHLY MAGAZINE.

Price Sixpence, Monthly.

Edited by C. G. BARRETT, G. C. CHAMPION, F.Z.S., J. W. DOUGLAS,
W. W. FOWLER, M.A., F.L.S., R. McLACHLAN, F.R.S., E. SAUNDERS,
F.L.S., and

LORD WALSHINGHAM, M.A., LL.D., F.R.S.

This Magazine, commenced in 1864, contains standard articles and notes
on all subjects connected with Entomology, and especially on the Insects of
the British Isles.

Subscription—Six Shillings per Annum, post free.

London: GURNEY & JACKSON (Mr. Van Voort's Successors),
1 Paternoster Row.

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
*Three Lines in Column	0	2	6
Per Line after	0	0	9
One Eighth Page, or Quarter Column	0	18	6
Quarter Page, or Half a Column	1	15	0
Half a Page, or a Column	3	5	0
Whole Page	6	6	0

* The first line being in heavy type is charged for as Two Lines.

The N. & G. Cameras

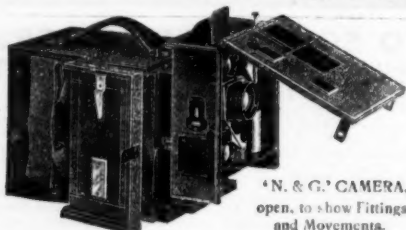
In all sizes up to 7 x 5 in.
For Plates, Cut Films, or Film
in Spools.

For Hand and Tripod.

A Series of High-Class Instruments for Serious Work,
embodying every New Advance in Photography.

Prices from £13 to £50.

Have been in Constant Use for Eight Years in all parts of the World.



N. & G. CAMERA,
open, to show Fittings
and Movements.

TRIPOD CAMERAS, SURVEYING CAMERAS, and very Small and
Light POCKET CAMERAS for Travellers and Field Naturalists.

Speciality: COMPLETE OUTFITS for Scientific Expeditions and Special Research.

Catalogues and Estimates + Lenses, Kinematographs, Lanterns, and all
free on application. Photographic Accessories and Materials.

Newman & Guardia, Ltd.

90 & 92 Shaftesbury Avenue, London, W.

JAS. J. HICKS,

8, 9 & 10 HATTON GARDEN, LONDON,
SCIENTIFIC INSTRUMENT MAKER

TO THE
WAR OFFICE, INDIA OFFICE, ADMIRALTY, &c
IS SOLE MAKER OF THE



NEW PATENT SPHYGMOMETER,

By Drs. HILL and BARNARD. It is of special construction and a simple and accurate arterial pressure gauge. It is marvellously sensitive, and consists of a metal tambour, the expansion of which is exhibited in a highly magnified form by means of an index or pointer which travels round a dial. The dial is graduated in millimetres of mercury. The armlet, pump, and pressure gauge fit conveniently into a leather case when not in use. By means of this instrument the arterial pressure can be taken in man as rapidly, simply, and accurately as the temperature can be taken with the clinical thermometer.

Price of Sphygmometer, £5.
Spare Bag and Tube, 5s.

Descriptive Pamphlet of Sphygmometer, with Hundreds of Experiments by various Doctors, now ready, sent Free on Application.

OPPOSITE THE BRITISH MUSEUM.

THACKERAY HOTEL

(TEMPERANCE).

GREAT RUSSELL STREET, LONDON.

THIS newly-erected and commodious Hotel will, it is believed, meet the requirements of those who desire all the conveniences and advantages of the larger modern licensed hotels at moderate charges. Passenger Lift. Electric Light in all Rooms. Bath-rooms on every Floor. Spacious Dining, Drawing, Writing, Reading, and Smoking Rooms. All Floors Fireproof. Perfect Sanitation. Night Porter. Telephone. Bedrooms from 2s. 6d. to 4s. 6d. per night. Full Tariff and Testimonials on application.

Telegraphic Address: "THACKERAY, LONDON."

Proprietor—J. TRUSLOVE.

Also, amalgamated with, and under the same management,

ESMOND HOTEL

(TEMPERANCE).

MONTAGUE STREET, RUSSELL SQUARE.

THIS Hotel, which has been carried on so successfully for the last 13 years, adjoins the British Museum, and is exceptionally quiet. Bedrooms from 2s. to 3s. 6d. per night. Full Tariff and Testimonials on application.

Telegraphic Address: "TRUSLOVE, LONDON."

Proprietor—J. TRUSLOVE.

THE SCIENTIFIC MAN'S, NATURALIST'S, AND TRAVELLER'S CAMERA

IS THE

Stereoscopic Company's BINOCULAR,

Because when ready to take 12 Pictures it weighs 19 ounces only.

It is used like a Field Glass. Takes instantaneous and time exposures. Gives Pictures 7 in. by 5 in. when used with the simple printing and enlarging apparatus. Price £5 5s. only. Complete with enlarging apparatus, £10 10s. Also made in larger sizes. FREE Lessons to Purchasers.

From R. BOWDLER SHARPE, Esq., LL.D., Assistant Keeper, Zoological Department, British Museum.

"I have received the remainder of the proofs of my photographs, and I must say that I am delighted with them. I consider it one of the best day's work I ever did when I bought one of your 'Binocular' Cameras. The ease with which it is worked, and the excellent results obtained, make it a most pleasurable accompaniment of a summer's outing, and, in my case, 90 per cent. of my Norway photographs have come out beautifully, while even the small remainder cannot be considered failures. I think this is a grand result, when you remember that I had little or no experience of photography, and had only time for an hour's instruction in your rooms the day before I sailed, and, further, that I had to make my own dark rooms in Norway in the best way I could. I am looking forward to having much pleasure this summer from the faithful 'Binocular,' and I have recommended it to all my friends."

THE STEREOSCOPIC COMPANY,

106 and 108 REGENT STREET, W., and 54 CHEAPSIDE, E.C.



CATALOGUES FREE.

Printed by RICHARD CLAY AND SONS, LIMITED, at 7 & 8 Bread Street Hill, Queen Victoria Street, in the City of London and published by MACMILLAN AND CO., LIMITED, at St. Martin's Street, London, W.C., and THE MACMILLAN COMPANY, 66 Fifth Avenue, New York.—THURSDAY, Feb. 1, 1900.



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 1580, VOL. 61]

THURSDAY, FEBRUARY 8, 1900.

[PRICE SIXPENCE

Registered as a Newspaper at the General Post Office.]

[All Rights are Reserved.]

SCOUTING AND OUTPOST TELESCOPE,

AS SUPPLIED TO THE WAR DEPARTMENT FOR
THE OFFICERS AT THE FRONT.



Magnifying 25-diameters, 42/-.

Also in **ALUMINIUM**, very light. Larger sizes up to
£5 : 15 : 6, magnifying 35 diameters.

FIELD GLASSES IN CASE,
40/-, 45/-, 90/-, 100/-.

NEWTON & CO.,
3 FLEET STREET, LONDON.
CATALOGUE, POST FREE.

BECK'S NEW MICROSCOPE THE "BRITISH STUDENTS."

Microscope Stand No. 55, as
figured, with Iris Diaphragm,
One Eye-piece; Double Nose-
piece, Two Object-glasses, 2/3"
and 1/6", adjusted to be in
about focus, and the whole
packed in polished Mahogany
Case.

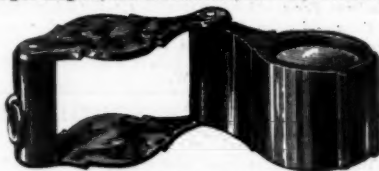


£6 : 8 : 6

No. 55.

R. & J. BECK, Ltd.,
68 CORNHILL, LONDON, E.C.

BROWNING'S PLATYSCOPIC LENS. With Larger Angles, Increased Field, and Improved Definition.



Engraved Real Size.

AN ACHROMATIC COMBINATION,
COMBINING THE DEFINITION OF A MICROSCOPE WITH THE
PORTABILITY OF A POCKET LENS.

"If you carry a small Platyscopic Pocket Lens (which every observer of
Nature ought to do)."—GRANT ALLEN in *Knowledge*.

The Platyscopic Lens is invaluable to botanists, mineralogists, or ento-
mologists, as it focuses about three times as far from the object as the
Coddington Lenses. This allows opaque objects to be examined easily.

The Platyscopic Lens is made of four degrees of power, magnifying
respectively 10, 15, 20, and 30 diams.; the lowest power, having the largest
field, is the best adapted for general use.

The Lenses are set in Ebonite Cells, and mounted in Tortoiseshell Frames.
Price of the Platyscopic Lens, mounted in Tortoiseshell, magnifying either

10, 15, 20, or 30 diameters, each power, 18s.

In nickel-plated German Silver, each power, 17s. 6d.

Illustrated Description sent free.

JOHN BROWNING, 63 STRAND, LONDON, W.C.

NEGRETTI & ZAMBRA'S LONG RANGE BINOCULARS AND TELESCOPES FOR MILITARY PURPOSES.

ILLUSTRATED PRICE LISTS FREE BY POST TO
ALL PARTS OF THE WORLD.

SPECIAL TERMS TO YEOMANRY TROOPS AND VOLUNTEER
CORPS REQUIRING SEVERAL GLASSES.



THE "READY-FOCUS" BINOCULAR.

A great
improvement over the ordinary systems
of Focussing.
Invaluable in watching moving
objects.

NEGRETTI & ZAMBRA,
SCIENTIFIC INSTRUMENT MAKERS TO THE QUEEN,
38, HOLBORN VIADUCT, E.C.
BRANCHES: 45 CORNHILL; 122 REGENT STREET.

THE DAVY-FARADAY RESEARCH LABORATORY OF THE ROYAL INSTITUTION.

DIRECTORS:

The Right Hon. LORD RAYLEIGH, M.A., D.C.L.,
LL.D., F.R.S.

Professor DEWAR, M.A., LL.D., F.R.S.

SUPERINTENDENT OF THE LABORATORY:

DR. ALEXANDER SCOTT, M.A., D.Sc., F.R.S.

This Laboratory was founded by Dr. Ludwig Mond, F.R.S., as a Memorial of Davy and Faraday, for the purpose of promoting, by original research, the development and extension of Chemical and Physical Science.

The Laboratory is open free of charge to Workers of either sex, and any nationality, prosecuting individual investigations; and the extensive collection of Physico-Chemical Apparatus presented by the Founder is available for their use, together with such materials, chemicals, electricity, &c., as the Directors may authorise.

Assistants and a trained mechanic are attached to the Laboratory to aid Workers in the prosecution of their researches.

All persons desiring to be admitted as Workers must send evidence of scientific training, qualification, and previous experience in original research, along with a statement of the nature of the investigation they propose to undertake.

Michaelmas Term.—Monday, October 2, to Saturday, December 16.

Lent Term.—Monday, January 8, to Saturday, April 7.

Easter Term.—Monday, April 30, to Saturday, July 28.

Forms of Application can be had from the ASSISTANT SECRETARY, Royal Institution, Albemarle Street, W.

NATURAL SCIENCE SCHOLARSHIP. KEBLE COLLEGE, OXFORD.

A SCHOLARSHIP of the annual value of £60, together with Laboratory Fees, not exceeding £20 per annum, will be awarded at this College in March 1900.

The Examination commences Tuesday, March 13.

Subjects: Chemistry or Biology, with Elementary Mechanics and Physics for all Candidates, and Elementary Chemistry for those who offer Biology.

For full particulars apply to W. HATCHETT JACKSON, Keble College, Oxford.

GEOLOGICAL SOCIETY OF LONDON.

The ANNIVERSARY MEETING of this Society will be held at the Society's Apartments, Burlington House, on FRIDAY, February 16, at Three o'clock.

The Fellows and their Friends will Dine together at the Criterion Restaurant, Piccadilly Circus, at 7.30 p.m. Tickets to be obtained at the Society's Apartments.

MATRICULATION, HOSPITAL SCHOLARSHIPS, &c.

PREPARATION by CORRESPONDENCE and ORAL TUITION on a THOROUGHLY INDIVIDUAL SYSTEM. Fees based on success.

The STAFF includes Graduates of Oxford, Cambridge, London, and Royal Universities, Science Medallists, Prizemen, Scholars, &c.

SINGLE SUBJECTS TAKEN: Latin, Greek, French, German, Mathematics, Science, Logic, Psychology, Political Economy, &c.

For Terms, &c., address Mr. J. CHARLESTON, B.A. (Lond. and Oxon.), The Burlington Classes, 27 Chancery Lane, London, W.C.

HEATHCOTE SCIENCE LABORATORIES.

These Laboratories are open for RESEARCH work, at any hours or times most convenient for worker, in CHEMISTRY, PHYSICS and BACTERIOLOGY. Facilities for Commercial investigations are supplied. Furnaces and powerful Electrical Currents can be used.

The Fees are at rate of £3 3s. for one month (five days a week, six hours a day). Apparatus supplied free.

Private Laboratory, £4 14s. 6d. a month, or by arrangement.

The above Fees include use of all ordinary Glass and other Apparatus, and use of Accurate Balances and Standard General Instruments, also Furnaces, &c.

9 Heathcote Street, Mecklenburgh Square,
Gray's Inn Road, W.C.

R. C. T. EVANS,
Director.

FOR SALE.—The "Journal of the Chemical Society" for the years 1888 to 1899 inclusive. Mostly bound. No reasonable offer refused.—Address, J. LEON, 60 Upper Berkeley Street, W.

BIRKBECK INSTITUTION, Breems Buildings, Chancery Lane, E.C.

Science Classes with Practical Work.

DAY AND EVENING CLASSES for University of London B.Sc.; Prelim. Scientific, Inter. M.B. Examinations and for Conjoint Board, Dental and Pharmaceutical Examinations.

EVENING CLASSES in all stages for Science and Art Department Examinations.

HIGHLY-EQUIPPED LABORATORIES.

Chemistry, Physics, Biology (Zoology and Botany), Metallurgy, Geology and Mineralogy, Microscopy.

Prospectus free. Calendar 6d. (Post 8d.) on application to Secretary.

HANDSWORTH TECHNICAL SCHOOL, STAFFS.

ASSISTANT MASTER. Wanted.—Mechanical Engineering Subjects, and with ability to help in Elementary Chemistry and Physics if required; teaching experience desirable. Salary, £125 per annum.

Apply, with copies of testimonials, and stating age, not later than 19th inst., to W. J. HARRIS, Honorary Secretary.

MUNICIPAL SCIENCE, ART AND TECHNICAL SCHOOLS, PLYMOUTH.

WANTED, an ASSISTANT MASTER, mainly for Elementary Science Work. Must be qualified to give Manual Training in Wood and Metal Work. Whitworth Scholar preferred. Salary, £100; rising to £120.

Further particulars from T. W. BYFIELD, Secretary.

LETCHER & SONS (formerly Letcher Bros.), SCIENTIFIC INSTRUMENT MAKERS, 25 TURNPIKE LANE, HORNSEY, N.

BLOWPIPE CABINETS. SPECIALITY: SOCIETY OF ARTS SETS.

W. G. PYE & CO. Physical & Physiological Instrument Makers, "GRANTA" WORKS, MILL LANE, CAMBRIDGE

(Late 30 ST. ANDREW'S STREET, CAMBRIDGE).

CHEAP AND EFFICIENT APPARATUS FOR SCIENCE SCHOOLS A SPECIALITY.

Reliable Apparatus at low prices for teaching Mechanics, Hydrostatics, Heat, Optics, Magnetism, Physiology and Electricity, as supplied to many of the leading Technical Institutes and Organised Science Schools.

CATALOGUES ON APPLICATION AND CORRESPONDENCE INVITED.

EVERETT & CO., MECHANICAL ENGINEERS AND ELECTRICIANS,

22 CHARTERHOUSE SQUARE, E.C.

Makers of High-Grade Physical and Electrical Apparatus. Apparatus designed and made for Laboratories and Research Work. ALL KINDS OF EXPERIMENTAL WORK.

HIGH-CLASS WORKMANSHIP AND ACCURACY A SPECIALITY.

MODELS DESIGNED, &c.

REPAIRS OF EVERY DESCRIPTION.

BARGAINS IN SCIENTIFIC BOOKS.

CAMPBELL (D. H.), THE STRUCTURE

AND DEVELOPMENT OF THE MOSSES AND FERNS (ARCHÉGONIATÆ). By DOUGLAS HOUGHTON CAMPBELL, Ph.D. Fully Illustrated. Medium 8vo. (Pub. 12s. net.) 4s.
"Dr. Campbell's book is clearly written, well illustrated, is provided with an accurate bibliography and a copious index, so that it will take its place at once as a standard classic, and will, we think, retain that position for no inconsiderable period."—*Gardener's Chronicle*.

BATESON (W.), MATERIAL FOR THE

STUDY OF VARIATION, treated with especial regard to Discontinuity in the Origin of Species. By WILLIAM BATESON, M.A., Fellow of St. John's College, Cambridge. 8vo, Cloth. (Pub. 21s. net.) 5s.

"The whole work must be carefully read by every serious student; and there can be no question of its great and permanent value as a contribution to our knowledge of a particular class of variations, and as a stimulus to further work in a department of knowledge which is too much neglected."—*Nature*.

HEADLEY (F. W.), THE STRUCTURE

AND LIFE OF BIRDS. By F. W. HEADLEY, M.A., F.Z.S., Assistant Master in Haileybury College. With 78 Illustrations. Crown 8vo, Cloth. (Pub. 7s. 6d.) 1s. 6d.

"We know of no book, at any rate, no modern book, which covers precisely the ground of Mr. Headley's Manual; it strengthens decidedly a weak point in Ornithological literature, and this fact, coupled with the excellence of the illustrations, should ensure for it a wide circulation."—*Ibid.*

COUES (Prof. ELLIOTT), HANDBOOK

OF FIELD AND GENERAL ORNITHOLOGY, a Manual of the Structure and Classification of Birds, with Instructions for Collecting and Preserving Specimens. Illustrated. Demy 8vo, Cloth. (Pub. 10s.) 2s. 6d.

The volume consists of two distinct parts:—PART I.—Field Ornithology contains the necessary Instructions for the Observation and Collection of Birds in the field, and for the Preparation and Preservation of Specimens for scientific study in the Cabinet. PART II.—General Ornithology is a technical Treatise of the Classification, the Zoological Characters, and the Anatomical Structure. CHAPTERS.—Implements for Collecting and their Use—Dogs—Suggestions and Directions for Field-work—Hygiene of Collectorship—Registration and Labelling—Instruments—Materials and Fixtures—How to make a Bird-skin—Collection of Nests and Eggs—Care of a Collection—Definition of Birds—Principles and Practice of Classification—Definitions and Descriptions of the Exterior Parts of Birds—An Introduction to the Anatomy of Birds.

Postage 3d. extra on one, or 6d. on four.

H. J. GLAISHER, New and Remainder Bookseller, 57 Wigmore Street, London, W.

Catalogues Post Free on application.

THE SCIENTIFIC ROLL AND MAGAZINE OF SYSTEMATIZED NOTES.

THIS WORK IS A VALUABLE
GUIDE, BIBLIOGRAPHY, AND INDEX TO SCIENCE.

In preparation.

BACTERIA (Botanical Section).

Although these are the simplest of plants, there is probably no group of organisms which exceeds them in interest or importance. Their operations affect the *welfare of every member of the community*, as also of the whole organic world. A full knowledge of them is essential in all questions bearing upon public and private health, agriculture, the microbial diseases of animals and of plants; and it is important in many industries, such as those dealing with milk, butter, hay, flax, tobacco, and others.

The group will be dealt with in three octavo volumes of about 500 pp. each. The subscription price will be 10s. for each volume, payable on delivery of the first number of the volume; or arrangements may be made to supply only the portions relating to a particular species, genus, or topic, at a proportionately reduced rate. The first volume will be commenced next summer, and if sufficient subscribers support the work, the three volumes will be completed in three years. As all the matter will be systematized, the series will be equivalent to a good bacteriological library, with the advantage that the information on any particular point will be comprised within a comparatively few pages, and not scattered over thousands of pages in a host of journals and books.

The names and addresses of subscribers, and applications for prospectus may be sent to the undersigned.

The undersigned will be glad to hear from PRINTERS willing to give estimates for printing, and from PUBLISHERS willing to consider terms for publishing the above-mentioned work.

A. RAMSAY,
4 Cowper Road, Acton, London, W.

PHOENIX FIRE OFFICE, 19 LOMBARD ST., E.C., and 57 CHARING CROSS, S.W.

ESTABLISHED 1782

MODERATE RATES. ABSOLUTE SECURITY
ELECTRIC LIGHTING RULES SUPPLIED.
LIBERAL LOSS SETTLEMENTS.
PROMPT PAYMENT OF CLAIMS.

FRANCIS B. MACDONALD, SECRETARY.

LOSSES PAID OVER £22,000,000.

JUST OUT.

Demy 8vo, Uncut, Price 31s. 6d. net, by post 32s.

BRITISH DRAGONFLIES:

Being an Exhaustive Treatise on our Native Odonata; their Collection, Classification and Preservation.

By W. J. LUCAS, B.A., F.E.S.

Very fully illustrated with 27 Plates illustrating 39 Species, exquisitely printed in Colour, and numerous Black and White Engravings.

CRIES AND CALL NOTES OF WILD

BIRDS. A Popular description of the notes employed by our commoner British birds in their songs and calls. Illustrated by musical notation. By C. A. WITCHELL. 12s., by post 12s. 2d.

NATURALIST'S DIRECTORY for 1900.

Sixth year of issue. Invaluable to all Students and Collectors. 1s. 6d., by post 1s. 9d.

PRACTICAL TAXIDERMY. A Manual

of Instruction to the Amateur in Collecting, Preserving and Setting up Natural History Specimens of all kinds. By M. BROWNE, F.Z.S. 2nd Edition. 7s. 6d., by post 7s. 10d.

BOOK OF BRITISH HAWK MOTHS.

A Popular and Practical Manual for all Lepidopterists. Copiously illustrated from the Author's own exquisite drawings. By W. J. LUCAS, B.A. 3s. 6d., by post 3s. 9d.

VIVARIUM. Snakes, Lizards, and other

Reptiles, and How to Keep them in Confinement. By Rev. G. C. BATEMAN. Illustrated. 7s. 6d. net, by post 8s.

Full Catalogue on Application.

London: L. UPCOTT GILL, 170 Strand, W.C.

MR. EDWARD ARNOLD'S LIST.

ELEMENTARY NATURAL PHILO-

SOPHY. By ALFRED EARL, M.A., Assistant Master at Tonbridge School. With numerous Illustrations and Diagrams. Cloth, 4s. 6d.

A TEXT-BOOK OF PHYSICAL CHEM-

ISTRY. By Dr. R. A. LEHFELDT, Professor of Physics at the East London Technical College. Crown 8vo, Cloth, 7s. 6d.

MAGNETISM AND ELECTRICITY By

J. PALEY YORKE, of the N. Polytechnic Institute. Crown 8vo, 3s. 6d.

A MANUAL OF PHYSIOLOGY. By

LEONARD HILL, M.B., Lecturer in Physiology at the London Hospital Medical College. With numerous Illustrations and Diagrams. 6s.

LECTURES ON THEORETICAL AND

PHYSICAL CHEMISTRY. Part I. CHEMICAL DYNAMICS. By Dr. J. H. VAN 'T HOFF. Translated by Dr. R. A. LEHFELDT, Professor at the E. London Tech. Coll. One vol. Demy 8vo, 12s. net.

STEAM BOILERS. By George Halliday.

With numerous Diagrams and Illustrations. 400 pages. Crown 8vo, 5s.

ELECTRICAL TRACTION. By Ernest

WILSON, Wh.Sc., M.I.E.E., Professor of Electrical Engineering in the Siemens Laboratory, King's College, London. Crown 8vo, Cloth, 5s.

DAVIS'S PHYSICAL GEOGRAPHY. By

WILLIAM M. DAVIS, Professor of Physical Geography in Harvard University, assisted by WILLIAM H. SNYDER, Master in Science in Worcester Academy. 12mo., Cloth, 42s. pages, illustrated, 5s. 6d.

THE ELEMENTS OF EUCLID. Books

I.-VI. By R. LACHLAN, Sc.D., formerly Fellow of Trinity College, Cambridge. With alternative Proofs, Not s, Exercises, and a large collection of Riders and Problems. Crown 8vo, Cloth, 4s. 6d.

THE ELEMENTS OF ALGEBRA. By

R. LACHLAN, Sc.D., formerly Fellow of Trinity College, Cambridge. Crown 8vo, Cloth, with or without Answers, 2s. 6d. Answers separately, 1s.

HABIT AND INSTINCT: a Study in

Heredity. By C. LLOYD MORGAN, F.R.S. Principal of University College, Bristol, Author of "Animal Life and Intelligence," &c. Demy 8vo, 16s.

THE CALCULUS FOR ENGINEERS.

By Prof. JOHN PERRY, F.R.S. Third Edition. Crown 8vo, Cloth, 7s. 6d.

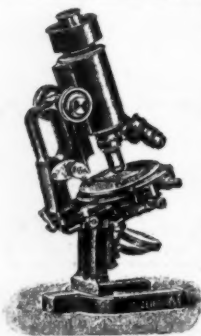
London: EDWARD ARNOLD, 37 Bedford Street, Strand.

THE GEOGRAPHICAL JOURNAL.

Price 2s. CONTENTS.—FEBRUARY.

A Journey through Abyssinia to the Nile. By Herbert Weld Blundell.
Hudson's Voyage to Spitzbergen in 1607. By Sir Martin Conway.
New Light on some Medieval Maps. By C. Raymond Beazley, M.A.
A Map of St. Kilda. By J. Norman Heathcote.
The Mashonaland Railway Survey.
Finland and its People. By Hugh Robert Mill, D.Sc.
Mrs. Bishop's Travels in China.
Journey to the Lakes Rakas-Tal and Manasarowar, in Western Tibet, undertaken in September, 1848. By General Sir Richard Strachey, R.E., G.C.S.I., F.R.S.
The Livingstone Exhibition.
The Monthly Record.
Obituary: General Tillo; Paulitschke.
Correspondence: The *Régime* of the Okavango River. Percy C. Reid.
Geographical Literature of the Month.
Numerous Maps and Illustrations.

EDWARD STANFORD, 26-27 Cockspur Street, Charing Cross, S.W.



CARL ZEISS,

OPTICAL WORKS, JENA.

LONDON BRANCH:

29 MARGARET ST., REGENT ST., W.

NEW

PHOTO-MICROGRAPHIC STAND

With very wide body-tube specially designed for working with our MICRO-PLANARS. It is also fitted with a new Fine-Adjustment of great accuracy and possessing a very slow movement.

These features render this Microscope pre-eminently suitable for Photo-micrography with the highest and lowest powers, as well as for ordinary visual observations.

DESCRIPTIVE PAMPHLET FREE ON APPLICATION.

MOORE'S HYDROSTATIC BALANCE

FOR ILLUSTRATING THE "PRINCIPLE OF ARCHIMEDES" AND SPECIFIC GRAVITY.

A is a delicate spring balance accurately graduated to read Grams, and is capable of being lowered or raised by the string shown.

B is one of the set of cubes of various metals supplied with the apparatus.

C is a glass vessel with fixed mark etched in glass, up to which water, or other liquid, is placed. The vessel is provided with draw-off cock.

Sole Makers of this Apparatus—

BREWSTER, SMITH, & CO.,

6 CROSS STREET, FINSBURY, E.C.

Manufacturers and Importers of Chemical and Scientific Apparatus and Pure Chemicals.

WEIGHTS a Speciality, 500 Milligrams to

1 Milligram, 1s. 6d. per doz.

SEND FOR COMPLETE ILLUSTRATED CATALOGUE.



FREDK. JACKSON & Co.

(Late MOTTERSHED & CO.),

14 CROSS STREET, MANCHESTER.

Goods Entrance: 10 Half-Moon Street,

LABORATORY FURNISHERS,

Importers, Manufacturers, and Dealers in

CHEMICAL AND PHYSICAL APPARATUS

Of every Description.

Fine Chemicals, Volumetric Solutions,
Plain and Stoppered Bottles,

AND EVERY LABORATORY REQUIREMENT.

Illustrated Catalogue of Apparatus, with Price List of Chemicals, free on application.

Telegraphic Address—"APPARATUS, MANCHESTER."

Telephone Number—2038.

Apparatus for estimation of sulphur in spent oxide.

J. & A. CHURCHILL,
PUBLISHERS.THE QUARTERLY JOURNAL OF
MICROSCOPICAL SCIENCE.

Edited by E. RAY LANKESTER, M.A., LL.D., F.R.S.,
with the co-operation of ADAM SEDGWICK, M.A.,
F.R.S., and W. F. R. WELDON, M.A., F.R.S.

Contents of No. 169 (February), with Eleven Plates, Price 10s.

Contributions to the Embryology of the Marsupialia. Parts II.
and III. By JAS. P. HILL, B.Sc. Edin., F.L.S., Demonstrator of Biology in the University of Sydney, New South Wales.

Studies in the Retina: Rods and Cones in the Frog and in some other Amphibia. By H. M. BERNARD, M.A. Cantab. (from the Biological Laboratories of the Royal College of Science).

On the Sensory Pit of the *Crotalinae*. By G. S. WEST, B.A., A.R.C.S., Student of St. John's College, Cambridge.

A Reinvestigation of the Early Stages of the Development of the Mouse. By J. W. JENKINSON, M.A.

The Structure of the Rostellum in two New Species of Tape-worm, from Apteryx. By W. BLAXLAND BENHAM, D.Sc., M.A., Professor of Biology in the University of Otago, New Zealand.

The Habits and Early Development of *Cerebratulus lacteus* (Verrill). A Contribution to Physiological Morphology. By CHAS. B. WILSON.

NEW WORK ON ALGEBRA.

ELEMENTARY ALGEBRA (TO QUAD-

RATICS). By C. H. FRENCH, M.A., and G. OSBORN, M.A., Mathematical Masters at the Leys School, Cambridge, formerly Scholars of Emmanuel College, Cambridge. Crown 8vo, 3s. 6d.; or with Answers, 4s. 6d.

A HANDBOOK OF PHYSICS AND

CHEMISTRY, adapted to the Requirements of the First Examination of the Conjoint Board of the Royal Colleges of Physicians and Surgeons, and also for General Use. By HERBERT E. CORBIN, B.Sc. Lond., and ARCHIBALD M. STEWART, B.Sc. Lond. With 120 Illustrations. Crown 8vo, 6s. 6d.

Professors CLOWES and COLEMAN'S

ILLUSTRATED CHEMICAL HANDBOOKS

For Colleges, Technical Institutes, Polytechnics, Organised Science Schools, and Schools generally.

PRACTICAL CHEMISTRY and QUALITATIVE ANALYSIS. Seventh Edition. 8s. 6d.

QUANTITATIVE ANALYSIS. Fourth Edition. 10s.

ELEMENTARY PRACTICAL CHEMISTRY and QUALITATIVE ANALYSIS. Second Edition. 3s. 6d. [Nearly ready.]

INTRODUCTION TO QUANTITATIVE ANALYSIS. 4s. 6d.

A MANUAL of BOTANY. By J. Reynolds

GREEN, Sc.D., F.R.S., Professor of Botany to the Pharmaceutical Society; Examiner in Botany to the University of London and the Victoria University. In Two Vols., with nearly 200 Illustrations.

Vol. I. MORPHOLOGY and ANATOMY. Second Edition. 7s. 6d.

Vol. II. CLASSIFICATION AND PHYSIOLOGY. 10s.

PRACTICAL PHYSIOLOGY, including

HISTOLOGY, CHEMICAL and EXPERIMENTAL PHYSIOLOGY. By DE BURGH BIRCH, M.D., F.R.S.E., Professor of Physiology in the Yorkshire College of the Victoria University; Additional Examiner in Edinburgh University. With 62 Illustrations. Crown 8vo, 6s. 6d.

HUMAN NATURE, ITS PRINCIPLES

AND THE PRINCIPLES OF PHYSIOGNOMY. (In Two Parts.) By PHYSICIST. Part I., 2s. Part II., 2s. 6d.

London: J. & A. CHURCHILL, 7 GREAT MARLBOROUGH ST.

TO INTENDING SUBSCRIBERS.

NOTICE MUST NOW BE GIVEN

That "THE STANDARD'S" Remarkable Introductory Offer regarding

The "LIBRARY of FAMOUS LITERATURE"

MUST BE WITHDRAWN.

READERS of the preliminary announcements which the *Standard* made regarding its issue of the new LIBRARY of FAMOUS LITERATURE will recall the express conditions upon which the present offer was made.

Instead of putting a very high price upon the first edition, with the intention of afterwards reducing this price from time to time, as has been the usual custom with publishers, the *Standard* announced that it would receive subscriptions in advance of the day of publication at the lowest price possible with the character and cost of the work. The result of this offer was an advance subscription for 3,000 sets before a single set could be delivered. Even after delivery was begun, the binders could hardly keep pace with the incoming subscriptions, so that now the orders for nearly 2,000 sets still remain unfilled. So long as it was impossible to make immediate delivery of the books, the *Standard* has kept its offer open, and, under this arrangement, more than 7,000 sets of THE LIBRARY have been subscribed for up to the present time.

WHAT OUR SUBSCRIBERS

"WORTH THEIR COST AS A GUIDE TO THE WORLD'S LITERATURE."

Glen Lyn, Parkstone, Dorset.

Although not fond of anthologies as a rule, I think Dr. Garnett and his collaborators have done splendidly. They appear to have packed into the twenty volumes as much good stuff as the space would contain, and their labours should prove of great value to busy men like myself.

The illustrations, paper, type, and binding are all excellent, and each volume is much lighter in weight—hence more convenient to hold when reading—than I had expected.

As every well-equipped Public Library will contain complete editions of most of the works from which extracts are given, your volumes ought to be worth their cost as a guide to the best literature of the world.

C. J. WHITTING.

Chairman Bournemouth Public Library Committee.

"AN ENDLESS SOURCE OF DELIGHT."

British Vice-Consulate, Spezia, Italy.

I have pleasure in acknowledging the receipt of the twenty volumes of THE INTERNATIONAL LIBRARY of FAMOUS LITERATURE, which reached me a few days ago. I find them an endless source of delight, and am very glad I became a subscriber to such an admirable work.

J. H. TOWSEY.

"A MOST INTERESTING AND VALUABLE ADDITION TO ONE'S LIBRARY."

Hatherlow, Raglan Road, Reigate.

I have received THE LIBRARY of FAMOUS LITERATURE, and heartily congratulate Dr. Garnett and his associates on the signal success of their undertaking. The selections are capital, and the whole makes a most interesting and valuable addition to one's Library.

This compilation will be especially useful to those who in these days of hard pressure and making of many books, find difficulty in using their leisure time to best advantage, and to such these twenty volumes will be invaluable, as nearly the whole field has been sampled, and it is doubtful whether there ever appeared a better introduction to the vast mass of ancient and modern literature.

SYDNEY T. KLEIN, F.L.S., F.R.A.S.

"THE IDEA CARRIED OUT WITH CONSUMMATE ABILITY AND SUCCESS."

The Manse, Windermere.

I am more than delighted with the volumes; they are a treasure and a treasury. The idea was a grand and ambitious one, and has been carried out with consummate ability and success. The contents have been chosen with discrimination and true literary discernment. The printing is excellent, the paper good, and the binding neat and strong. There is nothing like THE LIBRARY in the market.

(Rev. Dr.) WILLIAM ADAMSON.

SPECIAL INTRODUCTORY OFFER.

(NOW ABOUT TO BE WITHDRAWN.)

Those who subscribe now, in advance of publication, may obtain the Complete Work, Twenty Volumes, AT A REDUCTION OF FIFTY PER CENT. from the regular prices hereafter to prevail. The Library is not sold in parts or by single volumes, but only in complete sets. The entire Twenty Volumes will be sent, all at one time, upon a preliminary payment of but HALF-A-GUINEA; further payment, after the twenty volumes are in your home, to be at the rate of 9, 12, 15, or 21 shillings per month, according to the binding.

A tasteful and convenient bookcase will be supplied to subscribers at a low price.

A large force is now at work binding up the last sets of the present edition, so that not only will all present subscribers soon be supplied, but the remaining sets of the edition will also be ready for delivery at an early date. It is in view of these circumstances that the *Standard* now announces that its advance of publication offer must be withdrawn. The present arrangement, whereby it is possible to obtain THE LIBRARY at about half the regular price and the complete work, the entire twenty volumes, is sent to the subscriber all at one time, can remain open but a little while longer.

The twenty volumes of THE LIBRARY, in its different styles of binding, may be seen at the *Standard* Office, or at the establishment of Messrs. Chappell & Co., pianoforte manufacturers, 50 New Bond Street, or the *Standard* will send to any address, post paid, a large, handsomely illustrated Prospectus of one hundred pages, giving a complete account of THE LIBRARY, together with specimen pages, specimen illustrations, and the like.

THINK.

"A BENEFIT UPON THE ENTIRE ENGLISH-SPEAKING RACE."

2 Mitre Court, Temple, E.C.

I have already spent some very pleasant hours with my LIBRARY of FAMOUS LITERATURE. I think the title an admirable one, and quite justified in every way. The work is indeed what it professes to be. I anticipated with pleasure many hours of leisure to be spent with THE LIBRARY. Your earlier correspondents appear to me to have covered the entire field of praise, but if I am not too late to say so, I think one of its merits consists in supplying topics for family "table-talk" (which are apt at times to be exhausted), and in this way to stimulate appetite for the best kind of literature, and therefore consider that Dr. Garnett and his coadjutors have conferred a benefit upon the entire English-speaking race.

H. ANDERSON.

"PLEASED BEYOND MEASURE."

Gayton House, Ashted, Surrey.

Dear Sirs,—Now that I have received my copies of "Famous Literature," I am beyond measure pleased with them.

It seems to me, however, that the public should by some means be better acquainted with the real nature of the publication.

I find that comparatively few people know what a beautiful work it is.

Yours very truly,

(Signed) PAYNE JENNINGS.

HERE ARE THE TWENTY HANDSOME VOLUMES.

Just as they appear in the Special Bookcase made to contain the Library, which is supplied to Subscribers at a low price.

THE LIBRARY OF FAMOUS LITERATURE



SHOWING THE HANDSOME THREE QUARTER LEVANT MOROCCO BINDING IN THE SPECIAL BOOKCASE.

WHAT THIS GREAT WORK IS.

It is not easy to put in brief compass a description of a work that is itself a great library. The splendid collection which Dr. Garnett has edited has all literature in its field—all races and all times. THE LIBRARY of FAMOUS LITERATURE presents not merely the best of all the great authors that have ever lived, but likewise a panorama of life and letters from that dim, remote past when books first began to be made down to our own day.

Here, in succession, is "the glory that was Greece and the grandeur that was Rome." Here are the Middle Ages, lit by the flame of Dante's genius and sweetened by Chaucer's poetic gossip. Here the Renaissance sheds all its coruscating names—Shakespeare, Spenser, Jonson, Sidney, Marlowe, Bacon; while Cervantes bids chivalry adieu, and Montaigne gives laws to the modern gentleman. Here are the dandy essayists, diarists, and satirists of Queen Anne's day; here the Johnsonian thunder, and the early masters of the novel—Fielding, Smollet, Richardson, and Burney.

The nineteenth century is the most richly represented of all periods. Wordsworth's new worship of Nature, Lamb's cosy wit, Shelley's wild melodies, and Byron's "pageant of his bleeding heart" are here. Carlyle, Ruskin, Tennyson, Browning, Clough, Rossetti, Darwin, Spencer, Newman, Ibsen, Tolstoy, Turgenev, Hugo, and hundreds of writers who have contributed to the present revival of the novel are richly represented in THE LIBRARY.

Nor is mere wit despised, or humour neglected. In THE LIBRARY every mood finds its response; and in this vast collection the wisdom of Plato and the piety of Pascal are harmonised with the wit of Sheridan and the fun of Mark Twain.

INQUIRY FORM FOR THE 100-PAGE PROSPECTUS.

If you do not wish to cut this slip out, carefully state that you saw this notice in *Nature*, otherwise the Prospectus cannot be sent.

W. M. JACKSON, THE STANDARD,

23 St. Bride Street, E.C.

Having read in *Nature* your offer regarding the LIBRARY of FAMOUS LITERATURE I request that you send me your illustrated Prospectus.

Name.....

Address.....

CHARLES GRIFFIN & CO.'S LIST.

WORKS BY J. R. AINSWORTH DAVIS, M.A., F.Z.S.,
Professor of Biology, University College, Aberystwyth.

THE FLOWERING PLANT: FIRST

PRINCIPLES OF BOTANY. By Prof. J. R. AINSWORTH DAVIS, M.A., F.Z.S., University College, Aberystwyth. Very fully illustrated. THIRD EDITION. Revised and Enlarged. With an additional chapter on FERNS AND MOSSES. 3s. 6d. [Just out.]
"It would be hard to find a text-book which would better guide the student to an ACCURATE KNOWLEDGE of modern discoveries in botany."—*Journal of Botany*.

AN ELEMENTARY TEXT-BOOK OF

BIOLOGY. SECOND EDITION. In Two Volumes. Sold separately.

I.—VEGETABLE MORPHOLOGY AND PHYSIOLOGY. With Complete Index-Glossary and 128 Illustrations. 8s. 6d.

II.—ANIMAL MORPHOLOGY AND PHYSIOLOGY. With Complete Index-Glossary and 108 Illustrations. 10s. 6d.

"Certainly THE BEST 'BIOLOGY' with which we are acquainted."—*British Medical Journal*.

A ZOOLOGICAL POCKET-BOOK, or

Synopsis of Animal Classification with Definitions of Phyla, Classes, and Orders, Remarks and Tables. By Dr. EMIL SELENKA. Authorised English Translation by Prof. AINSWORTH DAVIS. Interleaved, Cloth limp, 4s.

"ACCURATE AND CLEAR."—*Lancet*.

By PROFESSOR STIRLING, M.D., Sc.D.

PRACTICAL PHYSIOLOGY (OUTLINES

OF). THIRD EDITION. Crown 8vo, extra. With numerous Illustrations. 12s. 6d.

Part I.—CHEMICAL PHYSIOLOGY.

Part II.—EXPERIMENTAL PHYSIOLOGY.

"One of the BEST MANUALS the student can possess."—*The Lancet*.

PRACTICAL HISTOLOGY (OUTLINES

OF). SECOND EDITION. Uniform with the above. Comprising a complete laboratory course, with numerous exercises. With 368 Illustrations. 12s. 6d.

"The volume proceeds from a MASTER in his craft. CONCISELY WRITTEN.—ADMIRABLY ILLUSTRATED,—useful, and reliable."—*The Lancet*.

Complete Catalogue Post Free on Application.

London: CHARLES GRIFFIN & CO., LTD., Exeter St., Strand, W.C.

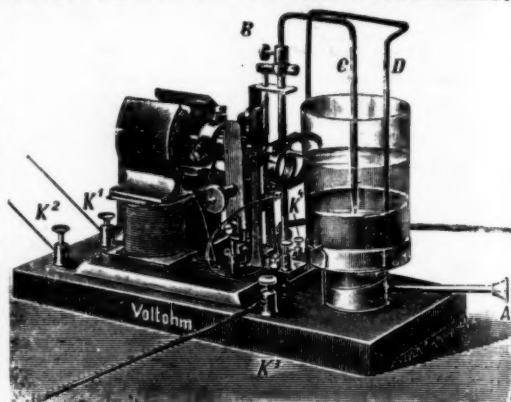
ISENTHAL, POTZLER & CO.,

85 MORTIMER STREET, LONDON, W.

Telegrams: "HYSTERESIS."

Telephone: 2099, GERARD.

CENTRAL DEPOT FOR RADIOGRAPHERS.



MERCURY BREAK.

Write for Lists, or better inspect our Installations.

HIGHEST REFERENCES.

EVERYTHING NOVEL AND ORIGINAL.

Sole Agents for Scotland:

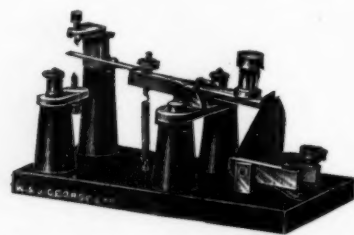
Messrs. JAMES WHITE,
Cambridge Street Glasgow.

"NIVOC" SPECIALITIES.

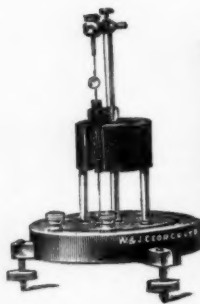
WORKS—BIRMINGHAM.

Buy direct from the Manufacturers.

THESE INSTRUMENTS ARE SPECIALLY
SUITED FOR WORKING TOGETHER.



KEMPE'S CHARGING & DISCHARGING KEY.
Improved Form with rubbing contacts, highly insulated, £3 15s. Highest quality and finish.



"NIVOC" MOVING COIL GALVANOMETER
BALLISTIC, very sensitive. To work with $\frac{1}{2}$ Micro-Farad Condenser, £2 10s.



STANDARD CONDENSER, $\frac{1}{2}$ Micro-Farad, £2 12s. 6d.

STANDARD CLARK CELL, 25s. net.

W. & J. GEORGE, LTD., 33-37 HATTON WALL, LONDON.
(Late F. E. BECKER & CO.)

DINES' PATENT PRESSURE PORTABLE ANEMOMETER.



For many years the want has been felt of a PORTABLE ANEMOMETER, by means of which the actual Velocity and Pressure of the Wind could be quickly ascertained. This want Mr. W. DINES, who is well known for his anemometrical experiments, has met by his PATENT PRESSURE PORTABLE ANEMOMETER.

One scale of the instrument shows *directly* the actual velocity of the wind; the other (not shown in the woodcut) the pressure exerted in pounds per square foot. The instrument is used vertically, with the nozzle pointing towards the wind.

FULL PARTICULARS SENT ON APPLICATION.

PRICE

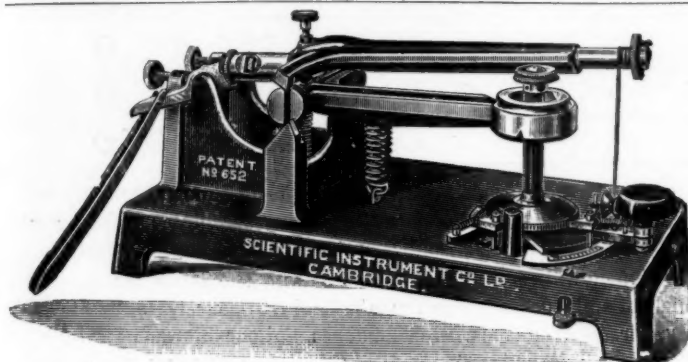
£3 10 0

L. CASELLA,

SCIENTIFIC INSTRUMENT MAKER TO THE ADMIRALTY AND ORDNANCE,
147 HOLBORN BARS, LONDON, E.C.

Telegraphic Address.
"EUTUCHION, LONDON."

Telephone.
"1064 Holborn."



THE CAMBRIDGE
SCIENTIFIC INSTRUMENT CO.,
Ltd., CAMBRIDGE.

NEW ROCKING MICROTOME.
1900 PATTERN. [PATENTED.]

This Instrument possesses the following great improvements over the old type of instruments:—
(1) Increased rigidity. (2) The impossibility of cutting thin and thick sections. (3) The impossibility of tearing sections on the upward movement of the object. (4) A graduated arc for showing the thickness of the sections. (5) Catch for holding the object above the edge of the razor. (6) Improved method of fixing the cord. (7) A new object holder.

PRICE (including object holder), £5 0 0
Write for Pamphlet descriptive of the above Instrument.

Address all communications:—
INSTRUMENT COMPANY, CAMBRIDGE.

NEW SCIENCE LANTERN.

SOLE MAKERS:
REYNOLDS & BRANSON,
Ltd.

IMPROVED
PORTABLE
DESIGN.



The Universal Science Lantern has been devised for the projection of experiments. In the short box in front of the lantern is a hinged mirror, so placed that by the movement of a stud it may be introduced and placed at an angle of 45 degrees with the parallel beam. The beam is thus sent upwards through a horizontal convergent lens, on which a slide or horizontal piece of apparatus can be placed. Above this is the objective mounted on a brass pillar, and above the objective a prism or mirror (if the screen is elevated above the lantern plain prisms are required for each beam), silvered on the outside so that there is no double reflection. The mirror can be adjusted to any angle, and is intended to send the image in an approximately horizontal direction to the screen. Slides can also be directly projected in the usual way.

The base-board is made to fold so that the lantern can be packed into a box 18½ x 8½ x 2½ with all its accessories *in situ*.

Price Complete, in Travelling Box, £9 0 0

REYNOLDS & BRANSON, LTD.
14 COMMERCIAL STREET, LEEDS.

A USEFUL COMPANION FOR THE SCIENTIFIC MAN.

Can be conveniently carried in the pocket, and, therefore, always handy for making notes.

Writes the moment it touches the paper.

Can be used in any position.

Has:—
A Nib of
14-carat Gold.

A Holder of the
Finest Vulcanised
Rubber.

A Perfect Feed, which
ensures absolute regularity of working.

Made in various styles, and with Nibs to suit all hands.

"E" PRICE LIST SENT POST FREE.

The YOST TYPEWRITER Co., Ltd.,
50 HOLBORN VIADUCT, LONDON, E.C.
WEST END DEPOT:—303 Oxford Street.

NOTICE.—The attention of the readers of this Journal is called to the

NATURE RE-ISSUE OF THE INTERNATIONAL SCIENTIFIC SERIES.

EIGHTY-SIX VOLUMES.

**A COMPLETE LIBRARY OF SCIENCE AT
A GREATLY REDUCED PRICE.**

PUBLISHERS' PRICE	...	...	...	...	£21 10 0
BY INSTALMENT (TO-DAY)	...	...	...	...	£14 14 0
FOR CASH	...	...	...	...	£13 10 0

The "International Scientific Series" has a world-wide reputation, and is to be found in every well-equipped Library throughout the English-speaking world. No more generous or acceptable present could be made to any Public Library or individual than this magnificent Encyclopædia of Scientific Research.

Most of the works are illustrated, and many with beautiful coloured plates. The Series has been contributed to by men of science of the highest eminence, such as Tyndall, Herbert Spencer, Walter Bagehot, Alexander Bain, Stanley Jevons, Huxley, Sir John Lubbock, G. J. Romanes, Balfour Stewart, Sir Norman Lockyer, Draper, Bonney, Sir Hubert Parry, Sir E. Maunde Thompson. This list only professes to convey a slight idea of the attention that has been given to the whole Series by the selection of only the best writers to deal with the various subjects considered.

This special offer is open only for a short time, and intending purchasers will do well therefore to send their orders without delay.

For the benefit of those who do not feel disposed to buy the entire Series, it will be possible to secure half the Series, making 43 volumes, for **£7** cash, or **£7 7s.** on the instalment system. The whole Series or half, as the case may be, will be sent on receipt of the first payment of One Guinea—the rest to be paid at the rate of £1 1s. per month.

NOTE:—OFFER OPEN ONLY FOR A SHORT TIME.

ORDER AT ONCE.

A Set of the Volumes may be seen at the Office of NATURE, ST. MARTIN'S STREET, W.C.

A Pamphlet, giving titles, &c., of the Works in the Series, Specimen Pages, with Illustrations, of some of the Volumes, also Order Form, will be sent Post Free on application to

C. WORSFOLD, "NATURE" Office, St. Martin's Street, London, W.C.

ORDER FORM.

Date.....1900.

All cheques should be crossed and made payable to **C. WORSFOLD, "NATURE" Office, St. Martin's Street, W.C.**

I enclose One Guinea as first payment for "NATURE'S Re-issue of the International Scientific Series," and I agree to pay to you, or your representative, the balance at the rate of One Guinea per month; my next payment to be on delivery of the volumes, and my remaining payments on the corresponding day of each month following.

Until such payments are complete, I engage that the Works, not being my property, shall not be disposed of by sale or otherwise.

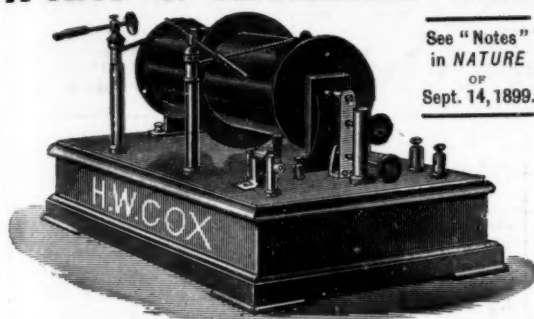
I further agree that if it be found impossible for any reason to deliver the books, the return of the sum of One Guinea to me shall cancel this agreement.

Name.....

Address.....

Residents abroad are kindly requested to remit in full, or to instruct their representatives in England to make the monthly payments, in order to avoid the expense and delay in forwarding cash from abroad.

X-RAY & ÆTHERIC TELEGRAPHY APPARATUS



See "Notes"
in NATURE
OF
Sept. 14, 1899.

OF THE HIGHEST QUALITY AND FINISH ONLY,
As supplied by us to H.M. Government and the leading
Hospitals and X-Ray Workers throughout the World.

We are the actual Manufacturers, and Guarantee
every Coil against breaking down.

CALL OR WRITE FOR OUR NEW ILLUSTRATED LIST, WITH
TESTIMONIALS AND ILLUSTRATED INSTRUCTIONS UPON HOW
TO WORK. POST FREE TO READERS OF "NATURE."

HARRY W. COX, Ltd.,
10, 11, 28 CURSITOR STREET,
CHANCERY LANE, LONDON.

Radiographs taken for Scientific and Medical Men, and
Demonstrations given.

T. TAMBLYN-WATTS, SCIENTIFIC APPARATUS MAKER.

Catalogue of Electrical Apparatus and Materials, 6d. Post free.
Catalogue of Balances and Weights, Apparatus for the Study
of Mechanics, &c., 6d. Post free.

GOLDIELANDS, SETTLE, YORKS.



GLASS BLOWING

GEISSLER TUBES IN BEAUTIFUL DESIGNS.

TUBES containing specimens of Fluorescent and Phosphorescent
Minerals, Salts, Rubies, &c.

ILLUSTRATED TUBE contains Vanes which Fluoresce in three
brilliant colours, and revolve by means of Cathode Rays.

COSSOR, 87 FARRINGDON ROAD, E.C.

PRISMS, of light, medium, dense, or very dense flints, of
guaranteed excellence.

NOTE.—As Mr. Hilger always keeps a large assortment of
high quality Optical Glass in stock, he is able to supply
Prisms of Glass suitable for any special purpose without
delay.

PRISMS of QUARTZ, or ICELAND SPAR,
accurately cut to give single refraction at the angle of minimum
deviation. Mr. Hilger has at present a large number of Iceland
Spar Prisms in stock.

DIRECT VISION PRISMS of any size, and of any
desired dispersion possible.

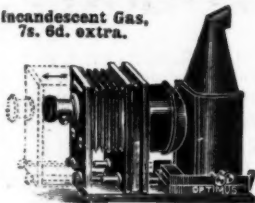
Right Angle Prisms, Speculum and Silvered Glass
Mirrors, Plane Parallel Glass Plates, &c., &c.

A. HILGER,

204, Stanhope Street, Hampstead Road, London, N.W.

"OPTIMUS" SANTILEVER PHOTOGRAPHIC ENLARGER.

Incandescent Gas,
7s. 6d. extra.



This already popular model
is finished in a very superior
and practical style. The lamp
gives a brilliant and even light.
The optical system is through-
out the best. The Lens will
be found to give a very flat
field and good marginal defini-
tion.

* SUITED FOR POCKET
CAMERA NEGATIVES.

Diam. of Condenser	4in.	5in.	6in.	8in.	10in.
Price, no Front Lens	62/-	70/-	82/-	110/-	200/-
Extra for Front Lens	27/-	27/-	37/-	63/-	63/-
Covering Plates	3 1/2 x 3 1/2	4 1/2 x 3 1/2	6 1/2 x 4 1/2	8 1/2 x 5 1/2	

Catalogue POST FREE.

PERKEN, SON & CO.,

"OPTIMUS" MAGIC LANTERNS FOR DRAWING ROOM AND LECTURE HALL.

Each Lantern is efficient for Exhibitions.
The Lens gives crisp definition, being a
superior Achromatic Photographic Combination,
with Rack and Pinion, compound Con-
denser of 4-in. diameter. Each has 3-wick
Refugent Lamp, and is Complete in box.
(4-wick Lamp, 2s. extra.)



Mahogany outside Body, Panelled Door,
Brass Stages, and 3-draw Sliding Tubes, so
that lenses of long focus may be used when
projecting upon a screen at a great distance, £5 5s.

Mahogany outside Body, lined with metal, making a
thoroughly practical instrument, and really good value ... £2 12 0

Russian Iron Body, Brass Sliding Tubes (Educational)... 3 3 0

Do. do. (College) ... 2 8 0

99 HATTON GARDEN,
HOLBORN CIRCUS, E.C. **LONDON.**

HARVEY & PEAK

(BY APPOINTMENT TO THE ROYAL INSTITUTION OF GREAT BRITAIN)

HAVE FOR DISPOSAL A NUMBER OF

NICOL PRISMS AND TOURMALINES of various Sizes.

PROJECTION POLARISCOPEs of various Sizes in Stock, with large Nicol Prisms:—

STUDENTS' SPECTROMETERS.—P. O. Bridge Sets, for Schools.—Induction Coils.—Wimshurst Machines.—

X-Ray Apparatus.—Optical Banks, &c., &c.

H. & P. are the actual Manufacturers of the above.

56 CHARING CROSS ROAD, LONDON W.C.

BORD'S PIANOS

25 per cent. Discount for Cash, or 14/6 per month (second-hand, 10/6 per month) on the Three Years' System. Lists free of
G. STILES & CO., 40 & 42 Southampton Row, London, W.C.
PIANOS EXCHANGED.

BECHSTEIN PIANOS

These magnificent Pianos for Hire on the Three Years' System at advantageous prices and terms. Lists and particulars free of
CHAS. STILES & CO., 40 & 42 Southampton Row, LONDON, W.C.

ESTABLISHED 1851. BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

INVESTED FUNDS

£10,000,000.

The BIRKBECK ALMANACK, with full particulars, post free.

FRANCIS RAVENSCHOFF, Manager.

THE MOST NUTRITIOUS.

E P P S'S

GRATEFUL—COMFORTING.

C O C O A

BREAKFAST—SUPPER.

THE IRISH NATURALIST.

A Monthly Magazine of Irish Zoology, Botany, and Geology. Price 6d.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD PRAEGER, B.A.

Annual Subscription, 4s. Post Free to any Address.

Dublin: EASON & SON, LTD., 40 Lower Sackville Street (to which Address Subscriptions should be sent).

London: SIMPKIN, MARSHALL, HAMILTON, KENT, & CO., Ltd.

TO SCIENCE LECTURERS. HUGHES' MOTO-PHOTOSCOPE FOR LIVING PICTURES. THE MOST PERFECT.

No SHUTTER, therefore no Flickering. Superb Mechanism. The Moto-Photo Camera for taking the Pictures. Illustrated Lists, 2d. See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN, &c. Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great success. New Oxyhydrogen Microscope. Science Lanterns for Class D-monstration. Magnificent Results. Docwra Triple, Prize Medal, Highest Award. Supplied to the Royal Polytechnic Institution, Dr. H. GRATTAN GUINNESS, Madame ADELINA PATTI, &c., &c. Patent Pamphengos Science Lanterns. The Universal Lantern 4-inch Condensers. 4-wick Lamp, Portrait Combination front Lenses, 18s. 6d., Marvellous value. Science Lecture Sets. Novelties. The Lantern Kaleidoscope. Cheapest Lantern Outfits in the World. Grandly Illustrated Catalogue, over 180 choice Engravings, 6d. Postage, 3d. List of 300 Lecture Sets, Science Subjects, Views, &c. 6d.; Postage 2d. Pamphlets Free. W. C. HUGHES, SPECIALIST, Brewster House, 82 Mortimer Road, Kingsland, N.

HOLLOWAY'S OINTMENT CURES

Gout, Rheumatism, Lumbago, Sciatica, Cuts, Bruises, Sprains, &c.

INVALUABLE FOR ALL SKIN DISEASES.

Holloway's Ointment and Pills may be obtained of all Medicine Vendors.

MACMILLAN & CO.'S NEW BOOKS. TEXT-BOOK OF PALÆONTOLOGY.

By KARL A. VON ZITTEL,

Professor of Geology and Palæontology in the University of Munich. Translated and Edited by CHAS. R. EASTMAN, Ph.D., Assistant in Palæontology in the Museum of Comparative Zoology at Harvard. With 1476 Woodcuts. Medium 8vo, 25s. net.

* * * This English Edition is revised and enlarged by the Author and Editor in collaboration with numerous Specialists.

A MANUAL OF ZOOLOGY.

By the late Prof. T. J. PARKER, D.Sc., F.R.S., and Prof. W. A. HASWELL, M.A., D.Sc., F.R.S. With Three Hundred Illustrations. Crown 8vo, 10s. 6d.

FIELD.—"For those who require a manual to assist them in acquiring an accurate knowledge of zoology, we know of no book superior to that under notice. . . . The illustrations are admirable. . . . We know of no work better fitted to fulfil the purpose for which it is designed than the one under notice. It is an admirable introductory text-book to scientific zoology."

No. 5, Vol. IX., NOVEMBER-DECEMBER, NOW READY.

THE PHYSICAL REVIEW.

A JOURNAL OF EXPERIMENTAL AND THEORETICAL PHYSICS.

CONDUCTED BY EDWARD L. NICHOLS, ERNEST MERRITT, AND FREDERICK BEDELL.

Price 3s. net.

CONTENTS:—On the Freezing Points of Aqueous Solutions of Non-electrolytes. By E. H. LOOMIS.—An Absolute Determination of the E.M.F. of the Clark Cell. By HENRY S. CARHART and KARL E. GUTHE.—The Resistance offered by Iron Wires to Alternating Currents. By ERNEST MERRITT.—On a Theorem of Clebsch's. By PAUL SAUREL.—An Investigation of the Magnetic Qualities of Building Brick. By O. A. GAGE and H. E. LAWRENCE.—Note.—New Books.—Index.

MACMILLAN & CO., LIMITED, LONDON.

NOTICE.—Advertisements and business letters for NATURE should be addressed to the Publishers; Editorial communications to the Editor. The telegraphic address of NATURE is "PHUSIS," LONDON.

SUBSCRIPTIONS TO "NATURE."

	£ s. d.	To ALL PLACES ABROAD:—£ s. d.
Yearly	1 8 0	Yearly 1 10 6
Half-yearly	0 14 6	Half-yearly 0 15 6
Quarterly	0 7 6	Quarterly 0 8 0

Cheques and Money Orders payable to MACMILLAN & CO., Limited.

CHARGES FOR ADVERTISEMENTS.

	£ s. d.		£ s. d.
* Three Lines in Column	0 2 6	Quarter Page, or Half a Column	1 15 0
Per Line after	0 0 9	Half a Page, or a Column	3 5 0
One Eighth Page, or Quarter Column	0 18 6	Whole Page	6 6 0

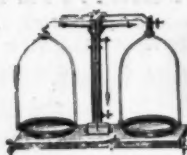
* The first line being in heavy type is charged for as Two Lines.

OFFICE: ST. MARTIN'S STREET, LONDON, W.C.



HARRIS'S ORIGINAL PATTERN ATWOOD MACHINE, 7012A, Accurate and Reliable, 8 to 9 feet high, Graduated, £3 15s.

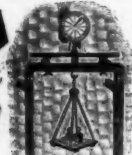
HARRIS'S SPECIALITIES.—CATALOGUES UPON APPLICATION.



Reliable Balances, P230A. 100 grm. to 1 mgm. Agate Planes and Knife Edges, £1 9s. 6d.; Steel, £1 4s.



Resistance Box, Post Office, £6 10s. 4775A.



New Mechanical Apparatus. See List.



Stroud and Rendell Lantern, £5. 6929A.

PHILIP HARRIS & Co. LTD.,
COMPLETE LABORATORY FURNISHERS, BIRMINGHAM.

Telegraphic Address :
"Science," Birmingham.
Telephone No. 10.

WATSON'S NEW MICROSCOPES AND APPARATUS.



WATSON'S HOLOSCOPIC EYEPIECES, for use with either APOCHROMATIC or ACHROMATIC OBJECTIVES, an adjustment being provided to the special lenses employed, for altering the correction. There is no sacrifice of efficiency, the performance being equal to the most expensive Compensating or Huyghenian Oculars.

Magnifying Powers—

6 in. tube length, 5, 7, 10, and 14 diameters.
10 in. " 7, 10, 14, and 20 "

PRICE, in Student's Size and Pattern, either power, 17/6 each.

For Full Particulars see Supplemental List, Post Free.

WATSON'S Parachromatic OIL IMMERSION CONDENSER.

Total aperture, 1.30; applanatic aperture exceeds 1.25. Undoubtedly the finest Condenser obtainable for high-power work. Optical part only ... £5 0'0

Completely mounted with Iris Diaphragm and Set of Stops ... £6 10'0

WATSON'S "SCHOOL" MICROSCOPE, New Model, complete with 1 in. Objective, in Case ... £3 3'0

WATSON'S "ROYAL" MICROSCOPE. A new model high-class instrument.

WATSON'S "FRAM" MICROSCOPE. A highest-class instrument at a very moderate cost.

BACTERIOLOGICAL APPARATUS. MICROTOMES. Apparatus for FIELD BOTANY and FIELD GEOLOGY. METAMORPHOSES and DISSECTED PREPARATIONS. BOTANICAL and PHYSIOLOGICAL MODELS.

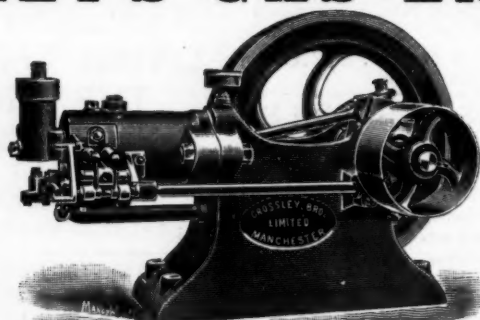
For Particulars of all the above, see Watson's New Supplemental List to Catalogue No. 2, Post Free on application.

Watson's Catalogue (No. 3) is a Classified List representing a Stock of 40,000 first-class Micro-Slides, Post free on application.

W. WATSON & SONS (Established 1837), Opticians to H.M. Government.
313 HIGH HOLBORN, LONDON, W.C. New Branch Now Open: 16 FORREST ROAD, EDINBURGH. And at 78 Swanston Street, Melbourne, Australia. Awarded 39 Gold and other Medals at the principal International Exhibitions of the World.

CROSSLEY'S GAS ENGINES.

RECENTLY
REMODELLED.



GREAT
REDUCTION
IN
GAS
CONSUMED.

CROSSLEY BROS., LTD., OPENSHAW, MANCHESTER.



DALLMEYER'S
POPULAR
HAND CAMERA.
PRICE
£7 7s.

Twelve 1-plates in sheaths, instantaneous changing, rack focussing, ever-set shutter with speed regulator, mahogany body covered good leather, and fitted with a STIGMATIC LENS, working at f. 7.5.

Send for fully Illustrated List of Lenses and Cameras.

J. H. DALLMEYER, Ltd., 25 Newman St., LONDON, W.



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

No. 1581, VOL. 61]

THURSDAY, FEBRUARY 15, 1900.

[PRICE SIXPENCE.

Registered as a Newspaper at the General Post Office.]

[All Rights are Reserved

NEWTON & CO.'S LOOK-OUT TELESCOPE.

Look-out Telescope, having a 3-in. Object-Glass, Body Tube of Brass, $3\frac{1}{2}$ feet long, fitted with Rack and Sliding Tubes for Adjustment, mounted Altazimuth with Metal Cradle and Bearings on Mahogany Stand, 5 feet high. The Terrestrial Eye-piece will show a church clock at 10 miles distance, and the Astronomical Eye-piece the Moon, Jupiter, Saturn's Ring, and divide many of the Double Stars. £7 10s.

CATALOGUE OF TELESCOPES ON APPLICATION.

NEWTON & CO.

OPTICIANS TO THE QUEEN AND GOVERNMENT,

3 FLEET STREET, LONDON.

A NEW GAS FURNACE

(Holloway's Patent)
FOR CHEMISTS AND ASSAYERS.



PARTS SEPARATE. LESS CRACKING.

All particulars from SOLE MAKERS:

JOHN J. GRIFFIN & SONS, LD.
20-26 SARDINIA STREET, LONDON W.C.

THE PROGRESSIVE SCIENCE SERIES.

NOW READY.

A BOOK OF WHALES.

BY THE EDITOR OF THE SERIES,

F. E. BEDDARD, M.A., F.R.S.

With Forty Illustrations by SIDNEY BERRIDGE.

Large 8vo, Cloth extra, fully Illustrated, 6s.

A COMPLETE LIST OF THE ABOVE SERIES CAN BE
OBTAINED POST FREE ON APPLICATION.

JOHN MURRAY, ALBEMARLE STREET, W.

NEGRETTI & ZAMBRA'S

LONG RANGE BINOCULARS AND TELESCOPES

FOR MILITARY PURPOSES.

ILLUSTRATED PRICE LISTS FREE BY POST TO
ALL PARTS OF THE WORLD.

SPECIAL TERMS TO YEOMANRY TROOPS AND VOLUNTEER
CORPS REQUIRING SEVERAL GLASSES.



THE
"READY-FOCUS"
BINOCULAR.

A great
improvement over the ordinary system
of Focussing.
Invaluable in watching moving
objects.

NEGRETTI & ZAMBRA,

SCIENTIFIC INSTRUMENT MAKERS TO THE QUEEN,

38 HOLBORN VIADUCT, E.C.

BRANCHES: 45 CORNHILL; 122 REGENT STREET.

NATURAL SCIENCE SCHOLARSHIP.

KEBLE COLLEGE, OXFORD.

A SCHOLARSHIP of the annual value of £60, together with Laboratory Fees, not exceeding £20 per annum, will be awarded at this College in March 1900.

The Examination commences Tuesday, March 13.
Subjects: Chemistry or Biology, with Elementary Mechanics and Physics for all Candidates, and Elementary Chemistry for those who offer Biology.
For full particulars apply to W. HATCHETT JACKSON, Keble College, Oxford.

CITY AND GUILDS CENTRAL TECHNICAL COLLEGE,

EXHIBITION ROAD, LONDON, S.W.

Required at once, an ASSISTANT, in the Electrical Engineering Department, with a good knowledge of Mathematical Physics, and with some experience, to take part in the general teaching, and in devising and arranging apparatus for a Junior Physical Laboratory. Salary to commence at £150 per annum, rising to £200.

Apply, in the first instance, by letter, stating age and career, to Prof. AWTON, at the College.

UNIVERSITY COLLEGE, LONDON.

PHYSIOLOGICAL DEPARTMENT.

A Course of Advanced Practical Physiology (including Experimental and Chemical Physiology) will be held during March and the first half of April.

The Course will be adapted to the requirements of the Examinations for the Int.M.B. and B.Sc.Lond. (Pass and Honours), as well as the corresponding Examinations at other Universities, and for the first F.R.C.S.

The Class will meet every weekday, except Saturdays, from 10 a.m. to 1 p.m. The first Class will be held on Monday, March 5th, 1900, at 10 a.m.

Gentlemen wishing to join this Class are requested to send their names as early as possible to Professor STARLING, at the Laboratory.

Fee for the Course, Five Guineas.

J. M. HORSBURGH, M.A., Secretary.

UNIVERSITY OF SOUTH WALES AND MONMOUTHSHIRE.

(A CONSTITUENT COLLEGE OF THE UNIVERSITY OF WALES.)

The Council invites applications for the Post of DEMONSTRATOR and ASSISTANT LECTURER in ANATOMY. Salary, £120.

Applications and testimonials, which need not be printed, should be sent on or before March 10th, 1900, to the undersigned, from whom further particulars may be obtained.

J. AUSTIN JENKINS, B.A.,
Secretary and Registrar.

Cardiff, 13th February, 1900.

B.A., PRELIMINARY SCIENTIFIC, B.Sc., and all other EXAMS.

QUERNMORE.

London Branches—(1) 24 CHANCERY LANE, W.C.; (2) 115 Ebury STREET, EATON SQUARE, S.W.

Special Preparation by JOHN GIBSON, M.A. (First Class, Cambridge), and G. LOLY, B.A. (First Class, London), assisted by large Staff of Specialist Tutors. Practical Laboratories. Write for particulars to Messrs. GIBSON & LOLY, 24 Chancery Lane, W.C.

MATRICULATION, HOSPITAL SCHOLARSHIPS, &c.

PREPARATION by CORRESPONDENCE and ORAL TUITION on a THOROUGHLY INDIVIDUAL SYSTEM. Fees based on success.

The STAFF includes Graduates of Oxford, Cambridge, London, and Royal Universities, Science Medallists, prizemen, Scholars, &c.

SINGLE SUBJECTS TAKEN: Latin, Greek, French, German, Mathematics, Science, Logic, Psychology, Political Economy, &c.

For Terms, &c., address Mr. J. CHARLESTON, B.A. (Lond. and Oxon.), The Burlington Classes, 27 Chancery Lane, London, W.C.

SCIENCE EXAMINATIONS.

For LONDON and other UNIVERSITIES, the JOINT BOARD, &c.

Well-equipped LABORATORIES, DAY AND EVENING. Personal or Class Tuition.

"R," 9 Heathcote Street, Gray's Inn Road, W.C.

FOR SALE—Cambridge Rocking Micro-

tome, Brass Water Bath with Pans of Silvered Copper, and stout Wooden Box containing 20 smaller Boxes for Slides, £5 10s.—Apply, "N," c/o NATURE Office.

Sales by Auction.

MONDAY NEXT, FEBRUARY 19TH.

An extensive and important Sale of Natural History Specimens, consisting of Cabinets of Shells, &c., Animal Heads, and Books, sold by Order of the Executors of the late Sir RAWSON H. RAWSON, Animal Skins, Skulls, Birds' Eggs, Birds' Skins; also set up in Glass Cases, Mammals, Skin and Skulls, valuable works by Westwood, Drury, Yarrell, Stephens, Hooker, Lindley, Huxley, and others, on Natural History, Botanical, and other Scientific Subjects, British and Continental Lepidoptera, quantity of Exotic ditto in papers, Glass Show Cases, &c., &c.

MR. J. C. STEVENS will Sell the above by Auction, at his Great Rooms, 38 King Street, Covent Garden, on Monday, February 19th, at half-past 12 precisely.

On view Saturday prior, from 10 till 4. Catalogues had on application, post free.

PRELIMINARY NOTICE.

TUESDAY AND WEDNESDAY, MARCH 27 AND 28.

THE "SAMUEL STEVENS" COLLECTION.

MR. J. C. STEVENS begs to announce that

he has received instructions from the Executors to Sell by Auction, at his Great Rooms, 38 King Street, Covent Garden, on Tuesday and Wednesday, March 27 and 28, the well-known Collection of British Lepidoptera, formed by the late SAMUEL STEVENS, Esq., the result of over sixty years collecting and breeding; consisting probably of over 100,000 specimens, and amongst them some wonderful and exceptional varieties of a very large number of species, and a long series of many rare and extinct species too numerous to mention.

On view day prior, to till 4. Catalogue in preparation, and can be had on application.

WATKINS & DONCASTER,

NATURALISTS,

AND MANUFACTURERS OF

CABINETS AND APPARATUS

FOR ENTOMOLOGY, BIRDS' EGGS, AND ALL BRANCHES OF NATURAL HISTORY.

SPECIAL SHOW-ROOM FOR CABINETS.

Call or send for detailed Catalogue (66 pp.), Post free on application.

N.B.—For Excellence and Superiority of Cabinets and Apparatus, references are permitted to distinguished patrons, Museums, Colleges, &c.

A LARGE STOCK OF INSECTS AND BIRDS' EGGS.

Birds, Mammals, &c., Preserved and Mounted by First-class Workmen with true natural surroundings. All Books and Publications on Natural History supplied.

36 STRAND, LONDON, W.C.

(Five Doors from Charing Cross.)

LIVING SPECIMENS FOR THE MICROSCOPE.

Volvox, Spirogyra, Desmids, Diatoms, Amoeba, Arcella, Actinosphaerium, Vorticella, Stentor, Hydra, Filicula, Stephanoceros, Melicerta, and many other Specimens of Pond Life. Price 12. per Tube, Post Free. Helix pomatia, Astacus, Amphioxus, Rana, Anodon, &c., for Dissection purposes.

THOMAS BOLTON,

25 BALSALL HEATH ROAD, BIRMINGHAM.

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM.

THE LABORATORY, PLYMOUTH.

The following animals can always be supplied, either living or preserved by the best methods:—

Sycon; Clava, Obelia, Sertularia; Actinia, Tealia, Caryophyllia, Alcyonium; Horniphora (preserved); Leptoplana; Lineus, Amphiporus; Nereis, Aphrodite, Areticola, Lanic, Terebella; Lepas, Balanus, Gammarus, Ligia, Mysis, Nebelia, Carcinus; Patella, Buccinum, Eledone, Pecten, Rugula, Crisia, Pedicellina, Holothuria, Asterias, Echinus; Ascidia, Salpa (preserved), Scyllium, Raja, &c., &c.

For prices and more detailed lists apply to Biological Laboratory, Plymouth

THE DIRECTOR.

PHENIX FIRE OFFICE,

19 LOMBARD ST., E.C., and 57 CHARING CROSS, S.W.

ESTABLISHED 1782

MODERATE RATES. ABSOLUTE SECURITY.

ELECTRIC LIGHTING RULES SUPPLIED.

LIBERAL LOSS SETTLEMENTS.

PROMPT PAYMENT OF CLAIMS.

FRANCIS B. MACDONALD, SECRETARY.

LOSSES PAID OVER £22,000,000.

BARGAINS IN SCIENTIFIC BOOKS.

COOKE (M. C.), THE BRITISH FUNGI,
A PLAIN AND EASY ACCOUNT OF, with Coloured Plates of
40 Species, Revised Edition, Crown 8vo. (Pub. 6s.) 2s. 6d.

"The new work on the fungi appears to be equally valuable with those which he has already printed. It contains descriptions of the esculent fungi, the manner in which they are prepared for the table, how to discriminate the nutritious from the poisonous species, details of the principles of their scientific classification, and a tabular arrangement of orders and genera."

— **HANDBOOK OF BRITISH HEPATICA**, containing Descriptions and Figures of the Indigenous Species of *Marchantia*, *Juggermania*, *Riccia*, and *Anthoceros*. Illustrated, Crown 8vo. (Pub. 6s.) 2s. 6d.

"Probably no group in the British flora has received so little attention as the Hepaticae. Dr. M. C. Cooke has now filled up the gap by producing a 'Handbook of the British Hepaticae,' containing full descriptions of all the species, about two hundred in number, known to inhabit the British Islands."—*Nature*.

— **MICROSCOPIC FUNGI: an Introduction to the Study of Microscopic Fungi, Rust, Smut, Mildew, and Mould.** Illustrated with 269 Coloured Figures by J. E. SOWERBY. Fifth Edition, Revised and Enlarged, with Appendix of New Species. Crown 8vo. (Pub. 6s.) 2s. 6d.

"Those of our readers who are the happy possessors of microscopes would welcome this book with delight, as opening the way to a definite study of a most interesting branch of plant life. The minute fungi, here so faithfully depicted by Mr. Sowerby, and so carefully described by Dr. Cooke, have not only beauty of form and colour, but wonderful life histories."

— **OUR REPTILES AND BATRACHIANS**, a Plain and Easy Account of the Lizards, Snakes, Newts, Toads, Frogs, and Tortoises, indigenous to Great Britain. New and Revised Edition, with Original Coloured Pictures of every Species, and numerous Woodcuts. Crown 8vo. (Pub. 6s.) 2s. 6d.

CONTENTS: Reptiles and Snake-stones, the Common Lizard, the Sand Lizard, the Green Lizard, the Natterjack, Palmate Newt, the Leatherly Turtle, the Blind Worm, the Common Snake, the Smooth Snake, the Viper or Adder, Great Water Newt, Gray's Banded Newt, Amphibia or Batrachians, the Common Frog, the Edible Frog, the Common Toad, Common Smooth Newt or Eft, the Hawk's-Bill Turtle, Appendix.

Postage 3d. extra on one, or 6d. on four.

H. J. GLAISHER, New and Remainder Bookseller, 57 Wigmore Street, London, W.

Catalogues Post Free on application.

THE SCIENTIFIC ROLL AND MAGAZINE OF SYSTEMATIZED NOTES.

THIS WORK IS A VALUABLE
GUIDE, BIBLIOGRAPHY, AND INDEX TO SCIENCE.

In preparation.

BACTERIA (Botanical Section).

Although these are the simplest of plants, there is probably no group of organisms which exceeds them in interest or importance. Their operations affect the *welfare of every member of the community*, as also of the whole organic world. A full knowledge of them is essential in all questions bearing upon public and private health, agriculture, the microbial diseases of animals and of plants; and it is important in many industries, such as those dealing with milk, butter, hay, flax, tobacco, and others.

The group will be dealt with in three octavo volumes of about 500 pp. each. The subscription price will be 10s. for each volume, payable on delivery of the first number of the volume; or arrangements may be made to supply only the portions relating to a particular species, genus, or topic, at a proportionately reduced rate. The first volume will be commenced next summer, and if sufficient subscribers support the work, the three volumes will be completed in three years. As all the matter will be systematized, the series will be equivalent to a good bacteriological library, with the advantage that the information on any particular point will be comprised within a comparatively few pages, and not scattered over thousands of pages in a host of journals and books.

The names and addresses of subscribers, and applications for prospectus may be sent to the undersigned.

The undersigned will be glad to hear from PRINTERS willing to give estimates for printing, and from PUBLISHERS willing to consider terms for publishing the above-mentioned work.

A. RAMSAY,
4 Cowper Road, Acton, London, W.

LETCHER & SONS (formerly Letcher Bros.),

SCIENTIFIC INSTRUMENT MAKERS,
25 TURNPIKE LANE, HORNSEY, N.

BLOWPIPE CABINETS. SPECIALITY: SOCIETY OF ARTS SETS.

JUST OUT.

Demy 8vo, Uncut, Price 31s. 6d. net, by post 32s.

BRITISH DRAGONFLIES:

Being an Exhaustive Treatise on our Native Odonata; their
Collection, Classification and Preservation.

By W. J. LUCAS, B.A., F.E.S.

Very fully illustrated with 27 Plates illustrating 39 Species, exquisitely printed in Colour, and numerous Black and White Engravings.

CRIES AND CALL NOTES OF WILD

BIRDS. A Popular description of the notes employed by our commoner British birds in their songs and calls. Illustrated by musical notation. By C. A. WITCHELL. 1s., by post 1s. 2d.

NATURALIST'S DIRECTORY for 1900.

Sixth year of issue. Invaluable to all Students and Collectors. 1s. 6d., by post 1s. 9d.

PRACTICAL TAXIDERMY. A Manual

of Instruction to the Amateur in Collecting, Preserving and Setting up Natural History Specimens of all kinds. By M. BROWNE, F.Z.S. 2nd Edition. 7s. 6d., by post 7s. 10d.

BOOK OF BRITISH HAWK MOTHS.

A Popular and Practical Manual for all Lepidopterists. Copiously illustrated from the Author's own exquisite drawings. By W. J. LUCAS, B.A. 3s. 6d., by post 3s. 9d.

VIVARIUM. Snakes, Lizards, and other

Reptiles, and How to Keep them in Confinement. By Rev. G. C. BATEMAN. Illustrated. 7s. 6d. net, by post 8s.

Full Catalogue on Application.

London: L. UPCOTT GILL, 170 Strand, W.C.

JUST PUBLISHED. 8vo. Price 15s. net.

THE KINETIC THEORY OF GASES.

ELEMENTARY TREATISE WITH MATHEMATICAL
APPENDICES.

By DR. OSKAR EMIL MEYER,
Professor of Physics at the University of Breslau.

Translated from the Second Revised Edition by

ROBERT E. BAYNES, M.A.,

Student of Christ Church, Oxford, and Dr. Lee's Reader in Physics.

LONDON: LONGMANS, GREEN, & CO.

Recently Published.

INSECTS: Their Structure & Life.

A PRIMER ON ENTOMOLOGY.

By GEORGE H. CARPENTER, B.Sc.Lond.

Cloth Gilt, 4s. 6d. net.

Knowledge says: "The beginner will here find an elementary account of the chief characteristics of insect life and habits which is altogether trustworthy."

Science Gossip says: "We can recommend Mr. Carpenter's little work as one well worth perusal, and one likely to be useful to its readers."

J. M. DENT & CO., 29 and 30 Bedford Street, W.C.

ALBERT EDWARD JAMRACH

(Late CHARLES JAMRACH),

NATURALIST,

180 ST. GEORGE STREET EAST.

Implements of Savage Warfare, Idols, Sacred Masks, Peruvian Pottery, Netsukis China, Lacquers, Gongs, Shells, and other Curios.

GAMBRELL BROTHERS,

17 Giltspur Street, LONDON, E.C.

Telegrams: "GAMBREUM LONDON."

Electricians and Manufacturers of HIGH GRADE ELECTRICAL AND PHYSICAL APPARATUS.

QUOTATIONS ON APPLICATION FOR ANY SPECIAL FORM OF APPARATUS.

WRITE FOR PRICE LIST.

CO-OPERATIVE WORLD TRAVEL

Organised by HENRY S. LUNN, M.D., F.R.G.S.
W. HOLDSWORTH LUNN & CONNOP F.S. PEROWNE.
A Cruise to GREECE, CONSTANTINOPLE, PALESTINE,
and EGYPT.

(Return Ticket to MARSEILLES included.)

A FORTY-TWO DAYS' CRUISE FOR £44 2s. AND UPWARDS.

s.v. ARGONAUT. Tonnage, 3254; h.p., 4000

£10 10s. and £13 13s. TOURS TO ROME.

Extensions to NAPLES, FLORENCE, VENICE,
and the ITALIAN LAKES.

Full particulars from the Secretary, 5 Endsleigh Gardens,
Euston, London, N.W.

CABINETS

ENTOMOLOGICAL AND ALL BRANCHES OF NATURAL HISTORY

J. T. CROCKETT & SON are ACTUAL MAKERS.

Great advantages in dealing direct with them.

ALL BEST WORK. ESTIMATES GIVEN.

SEND for Full DETAILED PRICE LIST BEFORE ORDERING ELSEWHERE.

7a PRINCES STREET, CAVENDISH SQUARE, LONDON, W.

Factories: 34 Riding House Street and Ogle Street, W.

SECOND-HAND ASTRO. TELESCOPES. &c.

4-inch by Troughton & Simms, Equatorial Mount with Clock.

4-inch by Cooke, Equatorial Mount.

3½-inch by Dallmeyer, Equatorial Mount.

Spectroscope with Diffraction Grating, £40.

Filar Micrometer by Browning, £15.

Large Transit Instrument by Troughton & Simms, 1½-inch

Object Glass, 14-inch Circles divided on Silver.

Several other Telescopes, also Microscopes and other Instruments,
by best Makers in Stock.

FULL LISTS ON APPLICATION.

C. BAKER, 244 HIGH HOLBORN, LONDON.

TO SCIENCE LECTURERS. HUGHES' MOTO-PHOSCOPE FOR LIVING PICTURES.

THE MOST PERFECT.

NO SHUTTER, therefore no Flickering. Superb Mechanism.

The Moto-Photo Camera for taking the Pictures. Illustrated Lists, 2d.
See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN,
&c. Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great
success. New Oxyhydrogen Microscope. Science Lanterns for Class
Demonstration. Magnificent Results. Docwra Triple, Prize Medals
Highest Award. Supplied to the Royal Polytechnic Institution, Dr. H. GRAT-
TAN GUINNESS, Madame ADELINA PATTI, &c., &c. Patent Pampango.
Science Lanterns. The Universal Lantern 4-inch Condensers. 4-wick Lamp.
Portrait Combination front Lenses, 18s. 6d., Marvellous value. Science
Lecture Sets. Novelties. The Lantern Kaleidoscope. Cheapest Lantern
Outfit in the World. Grandly Illustrated Catalogue, over 150 choice En-
gravings, 6d.; Postage, 2d. List of 300 Lecture Sets, Science Subjects,
Views, &c., 6d.; Postage 2d. Pamphlets Free. W. C. HUGHES,
SPECIALIST. Brewster House, 35 Mortimer Road, Kingsland, N.

BORD'S PIANOS

25 per cent. Discount for Cash, or 14/6 per month (second-hand, 10/6 per
month) on the Three Years' System. Lists free of

C. STILES & CO., 40 & 42 Southampton Row, London, W.C.

PIANOS EXCHANGED.

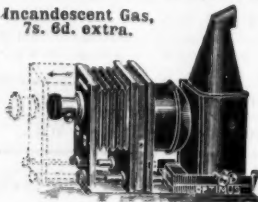
BECHSTEIN PIANOS

These magnificent Pianos for Hire on the Three Years' System at

advantageous prices and terms. Lists and particulars free of
CHAS. STILES & CO., 40 & 42 Southampton Row,
LONDON, W.C.

"OPTIMUS" CANTILEVER PHOTOGRAPHIC ENLARGER.

Incandescent Gas,
7s. 6d. extra.



This already popular model
is finished in a very superior
and practical style. The lamp
gives a brilliant and even light.
The optical system is through-
out the best. The Lens will
be found to give a very flat
field and good marginal defini-
tion.

* SUITED FOR POCKET
CAMERA NEGATIVES.

Diam. of Condenser	... 4in.	5in.	6in.	8in.	10in.
Price, no Front Lens	... 62/-	70/-	80/-	110/-	200/-
Extra for Front Lens	... 27/-	27/-	37/-	63/-	63/-
Covering Plates	... 34x34	44x34	64x44	84x54	...

Catalogue POST FREE.

PERKEN, SON & CO.,

"OPTIMUS" MAGIC LANTERNS FOR DRAWING ROOM AND LECTURE HALL.

Each Lantern is efficient for Exhibitions.
The Lens gives crisp definition, being a
superior Achromatic Photographic Combin-
ation, with Rack and Pinion, compound Con-
denser of 4-in. diameter. Each has 3-wick
Refracting Lamp, and is Complete in box.
(4-wick Lamp, 2s. extra.)



Mahogany outside Body, Panelled Door,
Brass Stages, and 3-draw Sliding Tubes, so
that lenses of long focus may be used when
projecting upon a screen at a great distance, £5 5s.

Mahogany outside Body, lined with metal, making a
thoroughly practical instrument, and really good value ... £2 12 0

Russian Iron Body, Brass Sliding Tubes (Educational)... 3 3 0

Do. do. (College) ... 2 8 0

99 HATTON GARDEN,
HOLBORN CIRCUS, E.C. LONDON.

A HANDSOME 100 PAGE PROSPECTUS

FULL OF ILLUSTRATIONS

Of the new "Library of Famous Literature," edited by Dr. RICHARD GARNETT, C.B.

SENT POST PAID TO ANY ADDRESS, together with full particulars of the *Standard's* remarkable offer

NOW ABOUT TO BE WITHDRAWN.

It is not the usual thing to send one book about another, still less to send the first book free. Yet that is precisely what the *Standard* does with regard to the issue of the great LIBRARY OF FAMOUS LITERATURE, which Dr. Richard Garnett, C.B., and a corps of the most distinguished men of letters have edited.

The Prospectus of the LIBRARY OF FAMOUS LITERATURE which the *Standard* sends is really a volume in itself. Many persons, indeed, in looking at this Prospectus cursorily, have mistaken it for the first volume of the Library. This Prospectus gives the fullest possible details as to the twenty handsome volumes which comprise the Library, and though it may be had for the trouble of sending a post-card, many have hesitated to send for it; they preferred to wait until they might have an opportunity to see the volumes themselves before thinking seriously of the purchase of the Library.

Obviously this is because the average prospectus is brief and contains but a few pages, and really gives very little idea of the work which it purports to describe. On the other hand, it is equally obvious that if every one of the 8,000 and more purchasers of the Library had waited until they had time to visit the *Standard's* office, or the establishment of Messrs. Chappell and Co., Piano-forte Manufacturers, 50, New Bond Street, W., where the volumes of the Library are on view, nothing like this number of copies of the Library would have been sold in the three or four months since the *Standard* made its first announcement.

WHY 8,000 PEOPLE HAVE PURCHASED THE LIBRARY.

If there are 8,000 people who would subscribe to a total of 160,000 large royal octavo volumes, and there have been more than this number, there must have been some special inducement why they should subscribe, and, further, some means of enabling them to subscribe with a fairly accurate idea of what they were doing. The special reason which induced the 8,000 and more subscribers to the LIBRARY OF FAMOUS LITERATURE to send their orders was the remarkable advance of publication offer which the *Standard* made when it announced the issue of this new work.

So far from pursuing the usual method of putting the highest possible price upon the first edition, the highest price which the reading public would stand, as is the usual custom in publishing, the *Standard* set aside what it has termed an Introductory Edition. The entire aim and purpose of this Introductory Edition was to put the LIBRARY OF FAMOUS LITERATURE into a considerable number of homes of Great Britain, so that the Library might become thoroughly and widely known. The *Standard* believed, first, that the earliest buyers of a book are usually those who care most for books, who have lived among them the longest, and know best their value; second, that the best judges of books are not as a rule those who do not have to count the cost of the things they buy.

The prices for the Introductory Edition of the Library were put at the lowest possible price consistent with a work of such character and value. In the same way the terms that were offered were such as had never before been made in Great Britain. For the preliminary payment of half-a-guinea the *Standard* agreed to send the complete work, the entire twenty volumes delivered all at one time, with further payments in small amounts each month. The effect of this arrangement was to put each one of the twenty volumes of the Library in the hands of the subscriber, so that he might be using them and enjoying them while he was paying for them in a convenient and leisurely way. But these prices and these terms were extended only to subscribers to the Introductory Edition. This edition is now almost all taken; a comparatively small number of sets now remain, and the *Standard* must therefore announce that this introductory offer must be withdrawn. Unless intending subscribers act quickly, and forward their orders within a few days, it will be too late.

Meanwhile the *Standard* wishes to give to such intending subscribers the utmost facility for making up their minds as to what the LIBRARY OF FAMOUS LITERATURE is, and whether they wish to have these twenty splendid volumes in their homes.

First, upon receipt of a post-card, the *Standard* will send post paid to any address PROSPECTUS No. 1.

SPECIAL INTRODUCTORY OFFER (NOW ABOUT TO BE WITHDRAWN.)

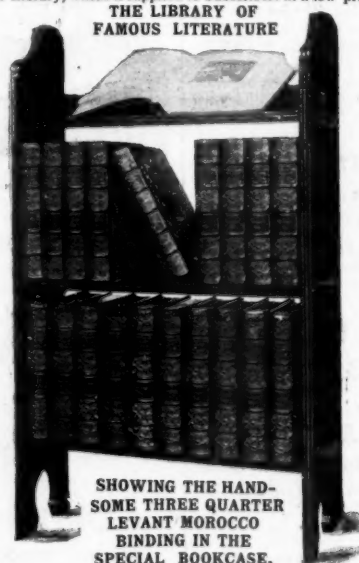
Those who subscribe now, in advance of publication, may obtain the Complete Work, Twenty Volumes, AT A REDUCTION OF FIFTY PER CENT. from the regular prices hereafter to prevail. The Library is not sold in parts or by single volumes, but only in complete sets. The entire Twenty Volumes will be sent, all at one time, upon a preliminary payment of but HALF-A-GUINEA; further payment, after the Twenty Volumes are in your home, to be at the rate of 9, 12, 15, or 21 shillings per month, according to the binding.

A tasteful and convenient bookcase will be supplied to subscribers at a low price.

HERE ARE THE TWENTY HANDSOME VOLUMES.

Just as they appear in the Special Bookcase made to contain the Library, which is supplied to Subscribers at a low price.

THE LIBRARY OF FAMOUS LITERATURE



SHOWING THE HANDSOME THREE QUARTER LEVANT MOROCCO BINDING IN THE SPECIAL BOOKCASE.

This is the large one-hundred page Illustrated Prospectus which is referred to at the top of this column. Note what it is and what it contains. Its pages are, to begin with, of the same size as the pages of the Library: they are set in the same type and printed on the same kind of paper. There are, moreover, facsimile reproductions of thirty pages from the Library itself. The contents of the Prospectus comprise:

1. A prospectus in brief, a concise description of the Library in forty lines.
2. A facsimile of the curious Greek manuscript of an oration of Demosthenes which forms the frontispiece of Volume 1. of the Library.
3. A series of twenty pictures of Dr. Garnett and the famous men of letters who have made the Library of Famous Literature.
4. What this great Library is (four pages).
5. Why the Library has come into existence (resuming a part of Dr. Garnett's introduction making of the Library).
6. What the Library contains (six pages).
7. From celebrated men of letters (telling of the eminent men who have contributed to the making of the Library).
8. The illustrations and some technical details (as to the bindings, coloured plates, indexes, &c.).

9. Specimens of the rare and quaint coloured plates which illustrate each volume of the Library.

10. Thirty specimen pages from the Library itself.

11. Three pages from the two large Indexes, General and Topical, included in the last volume of the Library (which occupy seven pages in full).

12. Seventeen full-page illustrations from among the five hundred full-page illustrations which illustrate the Library (these include reproductions of celebrated paintings, portraits of authors, their homes and the like).

PROSPECTUS No. 2.

This is a sixty-four page booklet giving the first one hundred letters from one hundred and fifty of the earliest subscribers to the Library, telling precisely what they think of it, how they like it, why they value it. These letters are the first among hundreds upon hundreds which the *Standard* has already received.

The booklet, which may be had on application, contains as well brief quotations from one hundred representative reviews and notices of the Library from the Press of Great Britain, and also some small reproductions, miniatures of the full-page illustrations of the Library itself.

WHAT THIS GREAT WORK IS.

It is not easy to put in brief compass a description of a work that is in itself a great library.

The splendid collection which Dr. Garnett has edited has all literature in its field—all races and all times. The LIBRARY OF FAMOUS LITERATURE presents not merely the best of all the great authors that have ever lived, but likewise a panorama of life and letters from that dim, remote past when books first began to be made down to our own day.

Here, in succession, is "the glory that was Greece and the grandeur that was Rome." Here are the Middle Ages, lit by the flame of Dante's genius and sweetened by Chaucer's poetic gossip. Here the Renaissance sheds all its coruscating names—Shakespeare, Spenser, Jonson, Sidney, Marlowe, Bacon; while Cervantes bids chivalry adieu, and Montaigne gives laws to the modern gentleman. Here are the dandy essayists, diarists, and satirists of Queen Anne's day; here the John-anian thunder, and the early masters of the novel—Fielding, Smollet, Richardson, and Burney.

The nineteenth century is the most richly represented of all periods. Wordsworth's new worship of Nature, Lamb's cosy wit, Shelley's wild melodies, and Byron's "pageant of his bleeding heart" are here. Carlyle, Ruskin, Tennyson, Browning, Clough, Rossetti, Darwin, Spencer, Newman, Ibsen, Tolstoi, Turgenev, Hugo, and hundreds of writers who have contributed to the present revival of the novel are richly represented in THE LIBRARY.

Nor is mere wit despised, or humour neglected. In the LIBRARY every mood finds its response; and in this vast collection the wisdom of Plato and the piety of Pascal are harmonised with the wit of Sheridan and the fun of Mark Twain.

INQUIRY FORM FOR THE 100-PAGE PROSPECTUS.

If you do not wish to cut this slip out, carefully state that you saw this notice in *Nature*, otherwise the Prospectus cannot be sent.

W. M. JACKSON, THE STANDARD,

23 St. Bride Street, E.C.

.....T900.

Having read in *Nature* your offer regarding the LIBRARY OF FAMOUS LITERATURE I request that you send me your Illustrated Prospectus.

Name.....

Address.....

SCOTTISH PROVIDENT INSTITUTION.

HEAD OFFICE: 6 St. Andrew Square, EDINBURGH.

MUTUAL ASSURANCE with MODERATE PREMIUMS.

More than one half of the Members who died during the Septennial period were entitled to Bonuses which, notwithstanding that the premiums do not as a rule exceed the non-profit rates of other Offices, were on the average equal to an Addition of about 50 per cent. to the Policies which participated.

The SURPLUS at last Division was £1,423,000.

Examples of Premium for £100 at Death, with Profits.

AGE.	30*	35	40	45	50	55
DURING LIFE,	£2 1 6	£2 6 10	£2 14 9	£3 5 9	£4 1 7	£5 1 11
25 PAYMENTS,	2 13 0	2 17 9	3 4 8	3 14 0	4 8 7	5 6 11
15 PAYMENTS,	3 12 1	3 18 0	4 5 8	4 16 2	5 11 8	6 9 11

* A person of 30 may secure £1000 at death by a yearly payment during life, of £20 15s., which would in many Offices secure (with profits) £2000 only. Or he may secure £1000 by 25 payments of £26 10s., being thus free of payment before age 55.

ACCUMULATED FUNDS, £11,000,000.

Prospectus, with full information, on application.

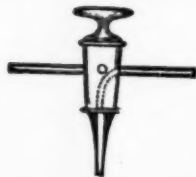
LONDON OFFICE: 17 KING WILLIAM STREET, E.C.

J. MUIR LEITCH, Secretary.

C. E. MÜLLER & CO., SCIENTIFIC GLASS BLOWERS

AND
MANUFACTURERS OF
CHEMICAL AND PHYSICAL APPARATUS.
X-Ray Tubes, Argon and Helium Spectrum Tubes,
Special Apparatus for Research, Chemical
Thermometers, &c., &c.

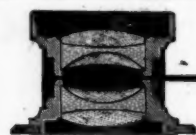
SPECIALITIES:
CHEMICAL THERMOMETERS.
GLASS STOPCOCKS.



PATENT DOUBLE SURFACE CONDENSER.
MERCURY PUMPS,
SPECTRUM TUBES, &c., &c.

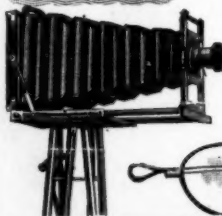
Price Lists and Particulars of above on application to

148 HIGH HOLBORN,
LONDON, W.C.



ROSS, Ltd.,

Manufacturers of Celebrated
ROSS' PORTRAIT AND VIEW LENSES
ROSS-ZEISS' ANASTIGMATIC LENSES
ROSS-GÖERZ' DOUBLE ANASTIGMATS
ROSS' NEW HAND-CAMERA LENSES
ROSS' FIELD AND STUDIO CAMERAS
ROSS' SPECIAL HAND CAMERAS
ROSS' NEW ENLARGING LANTERNS
ROSS' PATENT SCIENCE LANTERNS
ROSS' NEW ECLIPSE MICROSCOPES
ROSS' IMPROVED TELESCOPES
ROSS' FIELD AND OPERA GLASSES
ROSS' NEW PRISMATIC BINOCULARS
&c., &c., &c.



ROSS, Ltd.,

(ESTAB. 1830.)

MANUFACTURING OPTICIANS,
111 NEW BOND ST., LONDON, W.,
(AND)
31 COCKSPUR ST., CHARING
CROSS, S.W.



IMPROVED D'ARSONVAL GALVANOMETERS.

PRICES
£10-0-0

AND

£4-10-0

LIBERAL DISCOUNTS.



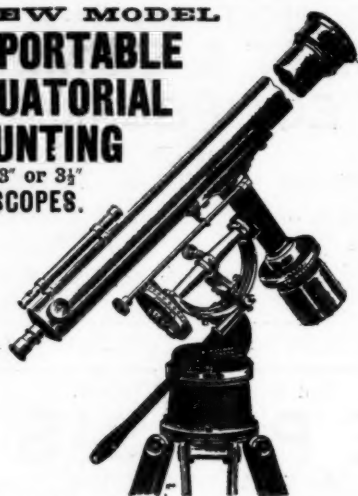
Most
SENSITIVE
for
DEFLECTIVE,
ZERO,
or
BALLISTIC
WORK.

Write for Price List and Particulars of Potentiometers,
Galvanometers, Electrical Thermometers, Experimental
Direct and Alternating Current Sets, &c., to

CROMPTON & CO., LD.,

Laboratory { "THRIPLANDS," } LONDON, W.
KENSINGTON COURT,

**NEW MODEL
PORTABLE
EQUATORIAL
MOUNTING**
For 3" or 3½"
TELESCOPES.



Latitude Adjustment, Clamp for Declination Axis, Quick and Slow Motion, in Right Ascension.

EQUATORIAL MOUNTING with Divided Circles and Stand fitted with short Iron Column, Levelling Screws, and Metal Stretcher, £15 15s.; or, complete with 3" Telescope, £25.

ILLUSTRATED CATALOGUE GRATIS.

**J. H. STEWARD
OPTICIAN.**

406 STRAND, 457 WEST STRAND,
7 GRACECHURCH STREET, LONDON.

JAS. SWIFT & SON,
MANUFACTURING OPTICIANS.



SOLELY APPOINTED TO THE A.M. DEPT.
WAR OFFICE, FOR THE SUPPLY
OF MICROSCOPES.

Patent form of Student's Microscope,
fitted with 2/3" and 1/6" Pan-Aplanatic
Objectives, Iris Diaphragm and Oculars,
in Case, from

£5 5s.

These Instruments we have supplied in
numbers to the following Medical Schools,
viz. St. Mary's, St. Bartholomew's, Guy's,
Middlesex, London, and St. Thomas's.
Seven Gold Medals awarded for excel-
lence of manufacture.

Catalogue on Application.

81 TOTTENHAM COURT ROAD, W.

GLASS BLOWING.

All kinds of Experimental Glass
Blowing carried out for Scien-
tific Men, Laboratories, &c.

INVENTORS' IDEAS WORKED OUT AS PER
INSTRUCTIONS.

COSSOR,
67 FARRINGTON ROAD, E.C.

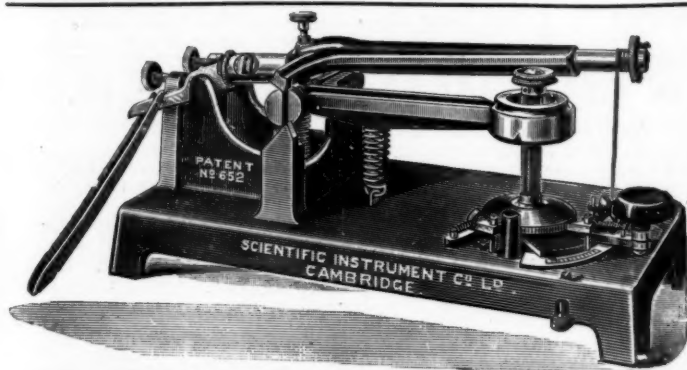


Shadow of
Cross Tube.

For Photography, Unsurpassed for fine definition.

COOKE LENSES

TAYLOR, TAYLOR, & HOBSON,
Stoughton Street Works, Leicester;
and 18 BERNERS STREET, LONDON, W.



THE CAMBRIDGE
SCIENTIFIC INSTRUMENT CO.,
Ltd., CAMBRIDGE.

NEW ROCKING MICROTOME.
1900 PATTERN. [PATENTED.]

This Instrument possesses the following great
improvements over the old type of instruments:—
(1) Increased rigidity. (2) The impossibility of
cutting thin and thick sections. (3) The impos-
sibility of tearing sections on the upward move-
ment of the object. (4) A graduated arc for show-
ing the thickness of the sections. (5) Catch for
holding the object above the edge of the razor.
(6) Improved method of fixing the cord. (7) A new
object holder.

PRICE (including object holder), £5 0 0

Write for Pamphlet descriptive of the above
Instrument.

Address all communications:—

INSTRUMENT COMPANY, CAMBRIDGE.

"No Better Food."

Dr. ANDREW WILSON, F.R.S.E., &c.

Fry's PURE CONCENTRATED **Cocoa**

250 Gold Medals and Diplomas.

N.B.—Just three words are necessary in order to obtain the right Cocoa,

viz. **FRY'S—PURE—CONCENTRATED.**

PHYSIOGRAPHY and GEOLOGY. COLLECTIONS & MICROSCOPIC SLIDES,

As advised by Science and Art Directory, arranged by
JAMES R. GREGORY & CO.,
Mineralogists, &c.,

To Science and Art Department, British, Indian and Colonial
Museums, &c.

**NOVELTIES and RARE GEMS and PRECIOUS
STONES.**

*Mineral Specimens for Museums, and Collectors, and all purposes.
Rock Specimens and Microscopic Sections of Rocks and Minerals
cut to order.*

**NEW AND VALUABLE MINERAL SPECIMENS CONSTANTLY
ARRIVING.**

Stores & Offices: 1 Kelso Place, KENSINGTON, W.

NEW CATALOGUES AND LISTS FREE.

MINERALS, ROCKS & FOSSILS.

COLLECTIONS FOR STUDENTS.

Carefully labelled and arranged in Boxes with Card Trays.

50 Minerals, 12/6; 100 do., 21/-; 200 do., 42/-.

Rocks and Fossils at similar prices.

300 Minerals in Cabinet, £4 4s.; 400 do., £5 12s. 6d.

Catalogues Post Free.

THOMAS D. RUSSELL,
78 NEWGATE STREET, LONDON, E.C.

HOLLOWAY'S PILLS

CURE

**Biliousness, Sick Headache, Indigestion, and
all Internal Complaints.**

CAN BE TAKEN BY THE MOST DELICATE.

Holloway's Pills and Ointment may be obtained of
all Medicine Vendors.

Now Ready, 8vo, Price 6s. net. RECENT & COMING ECLIPSES.

BY

SIR NORMAN LOCKYER, K.C.B., F.R.S.

Second Edition, containing an account of the observ-
ations made at Vizianagur, in India, in 1898, and of
the conditions of the Eclipses visible in 1900, 1901
and 1905.

MACMILLAN AND CO., LTD., LONDON.

THE MOST NUTRITIOUS.

E P P S'S

GRATEFUL—COMFORTING.

C O C O A

BREAKFAST—SUPPER.

ESTABLISHED 1851.

BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

INVESTED FUNDS

£10,000,000.

The BIRKBECK ALMANACK, with full particulars, post free.

FRANCIS RAVENSCROFT, *Manager.*

SCIENTIFIC WORTHIES.

The following is a list of the Steel Portraits that have appeared in the above Series:—

MICHAEL FARADAY.
THOMAS HENRY HUXLEY.
CHARLES DARWIN.
JOHN TYNDALL.

SIR GEORGE GABRIEL STOKES.
SIR CHARLES LYELL.
SIR CHARLES WHEATSTONE.
SIR WYVILLE THOMSON.
ROBERT WILHELM BUNSEN.
LORD KELVIN.
BARON ADOLF ERIK NOR-
DENSKJÖLD.

HERMANN L. F. HELMHOLTZ.
SIR JOSEPH DALTON HOOKER.
WILLIAM HARVEY.
SIR GEORGE B. AIRY.
J. LOUIS R. AGASSIZ.
JEAN BAPTISTE ANDRÉ DUMAS.
SIR RICHARD OWEN.
JAMES CLERK MAXWELL.
JAMES PRESCOTT JOULE.
WILLIAM SPOTTISWOODE.
ARTHUR CAYLEY.
SIR C. W. SIEMENS.

JOHN COUCH ADAMS.
JAMES JOSEPH SYLVESTER.
DMITRI IVANOWITSH MEN-
DELÉEF.
LOUIS PASTEUR.

SIR ARCHIBALD GEIKIE.
LORD LISTER.
STANISLAO CANNIZZARO.
PROF. VON KÖLLIKER.
PROF. SIMON NEWCOMB.

**N.B.—The Portraits of Sir A. Geikie, Lord Lister, Prof. Cannizzaro, Prof. von Kölliker, and
Prof. S. Newcomb belong to a New Series and are Photogravures.**

Proof impressions of these, printed on India paper, may be had from the Publishers, price 5s. each; or the Series
of 32 Portraits in a Handsome Portfolio for £8 5s., carriage paid. The Portfolio may be had separately, price 6s.

Cheques and Money Orders payable to MACMILLAN & CO., Limited.

OFFICE OF "NATURE," ST. MARTIN'S STREET, LONDON, W.C.

**NOTICE.—Advertisements and business letters for NATURE should be addressed to the Publishers; Editorial
communications to the Editor. The telegraphic address of NATURE is "PHUSIS," LONDON.**

SUBSCRIPTIONS TO "NATURE."

	£	s.	d.
Yearly	1	8	0
Half-yearly	0	14	6
Quarterly	0	7	6
TO ALL PLACES ABROAD:—			
Yearly	1	10	6
Half-yearly	0	15	6
Quarterly	0	8	0

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
*Three Lines in Column	0	2	6
Per Line after	0	0	9
One Eighth Page, or Quarter Column	0	18	6
Quarter Page, or Half a Column	1	15	0
Half a Page, or a Column	3	5	0
Whole Page	6	6	0

* The first line being in heavy type is charged for as Two Lines.

Cheques and Money Orders payable to MACMILLAN & CO., Limited.

OFFICE: ST. MARTIN'S STREET, LONDON, W.C.

MACMILLAN & CO.'S BOOKS

FOR

STUDENTS OF BOTANY.

PRACTICAL BOTANY for BEGINNERS. By Prof. F. O. BOWER, D.Sc., F.R.S. Globe 8vo. 3s. 6d.

A COURSE of PRACTICAL INSTRUCTION in BOTANY. By F. O. BOWER, D.Sc., F.R.S. Crown 8vo. 10s. 6d.

LABORATORY PRACTICE FOR BEGINNERS in BOTANY. By W. A. SETCHELL, Ph.D. Fcap. 8vo. 4s. 6d. net.

FIRST LESSONS in PRACTICAL BOTANY. By G. T. BETTANY, M.A., B.Sc., F.L.S. Pott 8vo. 1s.

BOTANY. By Sir J. D. HOOKER, F.R.S. With Illustrations. Pott 8vo. 1s.

The STUDENT'S FLORA of the BRITISH ISLANDS. By Sir J. D. HOOKER, F.R.S. Third Edition. Globe 8vo. 10s. 6d.

LESSONS in ELEMENTARY BOTANY. By DANIEL OLIVER, F.R.S. With numerous Illustrations. Third Edition, Fcap. 8vo. 4s. 6d.

FIRST BOOK of INDIAN BOTANY. By DANIEL OLIVER, F.R.S. With numerous Illustrations. Globe 8vo. 6s. 6d.

A TEXT-BOOK OF BOTANY. By Dr. E. STRASBURGER and Others. Translated by Dr. H. C. PORTER. 8vo. 18s. net.

GRAY'S BOTANICAL TEXT-BOOK (Sixth Edition).

Vol. I. **STRUCTURAL BOTANY: or Organography on the Basis of Morphology.** To which is added The Principles of Taxonomy and Phytography, and a Glossary of Botanical Terms. By ASA GRAY. 8vo. 10s. 6d.

Vol. II. **PHYSIOLOGICAL BOTANY.** I. Outlines of the History of Phenogamous Plants. II. Vegetable Physiology. By G. LINCOLN GOODALE, A.M., M.D. 8vo. 10s. 6d.

The STUDY of the BIOLOGY of FERNS by the COLLODION METHOD. For Advanced and Collegiate Students. By GEORGE F. ATKINSON, Ph.B. 8vo. 8s. 6d. net.

FLOWERS, FRUITS, and LEAVES. By LORD AVEBURY. With numerous Illustrations. Crown 8vo. 4s. 6d. [Nature Series.]

On BRITISH WILD FLOWERS, considered in Relation to Insects. With numerous Illustrations. By LORD AVEBURY. Crown 8vo. 4s. 6d. [Nature Series.]

The COLOURS of FLOWERS, as illustrated in the British Flora. By GRANT ALLEN. With Illustrations. Crown 8vo. 3s. 6d. [Nature Series.]

THE DAHLIA: Its History and Cultivation. By RICHARD DEAN, F.R.H.S., and Others. Illustrated. Crown 8vo. Price 1s. 6d. (paper, 1s.)

The BOOK of the ROSE. By Rev. A. FOSTER-MELLIAR. Illustrated. Extra Crown 8vo. 8s. 6d. net.

BRITISH FOREST TREES and their SYLVICULTURAL CHARACTERISTICS and TREATMENT. By JOHN NISBET, of the Indian Forest Service. Crown 8vo. 6s. net.

TIMBER and some of its DISEASES

By H. MARSHALL WARD, M.A., F.R.S., F.L.S. With Illustrations. Crown 8vo. 6s. [Nature Series.]

TEXT-BOOK of the DISEASES of TREES. By Professor R. HARTIG. Translated by Dr. W. SOMERVILLE. With a Preface by Prof. H. MARSHALL WARD, F.R.S. With numerous Illustrations. 8vo. 10s. net.

TIMBER and TIMBER TREES, Native and Foreign. By THOMAS LASLETT, Timber Inspector to the Admiralty. New Edition. Revised by Prof. H. MARSHALL WARD, F.R.S. Crown 8vo. 8s. 6d.

DISEASES of FIELD and GARDEN CROPS, chiefly such as are caused by Fungi. By W. G. SMITH, F.L.S., M.A.I. With 143 Illustrations. Fcap. 8vo. 4s. 6d.

THE SOIL: ITS NATURE, RELATIONS, AND FUNDAMENTAL PRINCIPLES OF MANAGEMENT. By Prof. F. H. KING. Fcap. 8vo. 3s. net.

IRRIGATION AND DRAINAGE. Principles and Practice of their Cultural Phases. By Prof. F. H. KING. Globe 8vo. 6s. [The Rural Science Series.]

FERTILISERS: The Source, Character, and Composition of Natural, Home-made, and Manufactured Fertilisers, and suggestions as to their use for different crops and conditions. By Prof. EDWARD V. VOOBHEES. Globe 8vo. 4s. 6d.

BUSH FRUITS. A Horticultural Monograph of Raspberries, Blackberries, Dewberries, Currants, Gooseberries, and other Shrub-like fruit. By Professor FRED W. CARD. Globe 8vo. 5s. net.

THE SPRAYING OF PLANTS. A Succinct Account of the History, Principles, and Practice of the Application of Liquids and Powders to Plants for the purpose of destroying Insects and Fungi. By E. G. LODGMAN. Globe 8vo. 4s. net. [The Rural Science Series.]

LECTURES ON THE EVOLUTION OF PLANTS. By Prof. DOUGLAS H. CAMPBELL, Ph.D. Crown 8vo. 4s. 6d. net.

VEGETABLE CULTURE. A Primer for Amateurs, Cottagers, and Allotment Holders. By ALEXANDER DEAN, F.R.H.S. Edited by J. WRIGHT. With Thirty-eight Illustrations. Pott 8vo. 1s.

A PRIMER of PRACTICAL HORTICULTURE. By J. WRIGHT, F.R.H.S. Pott 8vo. 1s.

GARDEN FLOWERS and PLANTS. A Primer for Amateurs. By J. WRIGHT, F.R.H.S. With Fifty Illustrations. Pott 8vo. 1s.

GREENHOUSE AND WINDOW PLANTS. A Primer for Amateurs. By CHARLES COLLINS. Edited by J. WRIGHT, F.R.H.S. With Thirty-eight Illustrations. Pott 8vo. 1s.

THE CHEMISTRY of the GARDEN. A Primer for Amateurs and Young Gardeners. By HERBERT H. COUSINS, M.A. With an Introduction by J. WRIGHT, F.R.H.S. Pott 8vo. 1s.

FARM AND GARDEN INSECTS. By WILLIAM SOMERVILLE, D.Æc. (Mon.), D.Sc. (Dun.) With Forty-six Illustrations. Pott 8vo., 1s.

MACMILLAN AND CO., LIMITED, LONDON.

MACMILLAN & CO.'S NEW BOOKS.

TEXT-BOOK OF PALÆONTOLOGY.

By KARL A. VON ZITTEL,

Professor of Geology and Palæontology in the University of Munich. Translated and Edited by CHAS. R. EASTMAN, Ph.D., Assistant in Palæontology in the Museum of Comparative Zoology at Harvard. With 1476 Woodcuts. Medium 8vo, 25s. net.

* * This English Edition is revised and enlarged by the Author and Editor in collaboration with numerous Specialists.

A MANUAL OF ZOOLOGY.

By the late Prof. T. J. PARKER, D.Sc., F.R.S., and Prof. W. A. HASWELL, M.A., D.Sc., F.R.S.

With Three Hundred Illustrations. Crown 8vo, 10s. 6d.

FIELD.—"For those who require a manual to assist them in acquiring an accurate knowledge of zoology, we know of no book superior to that under notice. . . . The illustrations are admirable. . . . We know of no work better fitted to fulfil the purpose for which it is designed than the one under notice. It is an admirable introductory text-book to scientific zoology."

SPECTATOR.—"The illustrations are excellent, one might almost say nearly perfect, and the volume generally needs no praise."

MALAY MAGIC.

BEING AN INTRODUCTION TO THE FOLKLORE AND POPULAR RELIGION OF THE MALAY PENINSULA.

By WALTER WILLIAM SKEAT,

Of the Civil Service of the Federated Malay States. With a Preface by C. O. BLAGDEN, Member of the Royal Asiatic Society, and formerly of the Straits Settlements Civil Service. With numerous Illustrations. 8vo, 21s. net.

NOTES ON SPORT AND TRAVEL. By GEORGE HENRY KINGSLEY, M.D.

With a Memoir by his Daughter, MARY H. KINGSLEY. With Portrait. Extra Crown 8vo, 8s. 6d. net.

FIELD.—"Fascinating. . . . It is a book to read from beginning to end, to keep amongst the intimate friends of the favourite bookshelf, and to take down again and again."

THE PRINCIPLES OF MECHANICS PRESENTED IN A NEW FORM.

By HEINRICH HERTZ, late Professor of Physics in the University of Bonn. With an Introduction by H. VON HELMHOLTZ. Authorised English Translation by D. E. JONES, B.Sc., District Inspector under the Department of Science and Art, &c., and J. T. WALLEY, M.A. 8vo, 10s. net.

VOLUME III. (COMPLETING THE WORK) NOW READY.

DICTIONARY OF POLITICAL ECONOMY. Edited by R. H. INGLIS PALGRAVE.

Vol. III. (completing the work). Medium 8vo, 21s. net. (Also Ready, Vols. I. and II., 21s. net each.)

STANDARD.—"Marks the conclusion of a financial work of more than ordinary importance. . . . The information has been well brought up to date. . . . Equally valuable to the student of finance or political economy and to the business community."

ECONOMIC JOURNAL.—"Its value is manifest: ample and trustworthy information, abundance of verified documents, bibliography of inappreciable value, it must be the *vade mecum* of him who wishes more knowledge."

INTRODUCTION TO PHYSICAL CHEMISTRY. By JAMES WALKER, D.Sc.,

Ph.D., Professor of Chemistry in University College, Dundee. 8vo, 10s. net.

LANCET.—"The book is written in such a lucid way as to render its perusal free from that irksomeness which is so often the student's experience when confronted with theoretical considerations. The book should serve as an admirable introduction to more advanced works."

NEW BOOK BY JOHN FISKE.

A CENTURY OF SCIENCE AND OTHER ESSAYS. Crown 8vo, gilt top, 8s. 6d.

LITERATURE.—"He always has something definite and original to say, and says it in lucid, forcible English. . . . The essays, though shorter and slighter than Froude's 'Short Studies,' remind us of them in their masculine quality and their wide culture."

SECOND EDITION NOW READY.

MARINE INSURANCE. A Handbook. By WILLIAM GOW, M.A. (Glasg.), Ph.D. (Heid.). Globe 8vo, 4s. 6d.

SECOND EDITION NOW READY.

THE MECHANISM OF WEAVING. By THOMAS W. FOX, Chief Lecturer in the Textile Department of the Municipal Technical School, Manchester. Crown 8vo, 7s. 6d.

MACMILLAN & CO., LIMITED, LONDON.

NOTICE.—SPECIAL RE-ISSUE BY NATURE
OF THE
INTERNATIONAL SCIENTIFIC SERIES
FOR A STRICTLY LIMITED PERIOD.
EIGHTY-SIX VOLUMES.

**A COMPLETE LIBRARY OF SCIENCE AT
A GREATLY REDUCED PRICE.**

PUBLISHERS' PRICE	...	...	...	...	£21	10	0
BY INSTALMENT (TO-DAY)	...	...	...	...	£14	14	0
FOR CASH	...	...	...	...	£13	10	0

The "International Scientific Series" has a world-wide reputation, and is to be found in every well-equipped Library throughout the English-speaking world. No more generous or acceptable present could be made to any Public Library or individual than this magnificent Encyclopædia of Scientific Research.

Most of the works are illustrated, and many with beautiful coloured plates. The Series has been contributed to by men of science of the highest eminence, such as Tyndall, Herbert Spencer, Walter Bagehot, Alexander Bain, Stanley Jevons, Huxley, Sir John Lubbock, G. J. Romanes, Balfour Stewart, Sir Norman Lockyer, Draper, Bonney, Sir Hubert Parry, Sir E. Maunde Thompson. This list only professes to convey a slight idea of the attention that has been given to the whole Series by the selection of only the best writers to deal with the various subjects considered.

This special offer is open only for a short time, and intending purchasers will do well therefore to send their orders without delay.

For the benefit of those who do not feel disposed to buy the entire Series, it will be possible to secure half the Series, making 43 volumes, for £7 cash, or £7 7s. on the instalment system, the purchaser himself selecting the volumes. The whole Series or half, as the case may be, will be sent on receipt of the first payment of One Guinea—the rest to be paid at the rate of £1 1s. per month.

NOTE:—OFFER OPEN ONLY FOR A SHORT TIME.
ORDER AT ONCE.

A Set of the Volumes may be seen at the Office of NATURE, ST. MARTIN'S STREET, W.C.

A Pamphlet, giving titles, &c., of the Works in the Series, Specimen Pages, with Illustrations, of some of the Volumes, also Order Form, will be sent Post Free on application to

C. WORSFOLD, "NATURE" Office, St. Martin's Street, London, W.C.

ORDER FORM.

Date.....1900.

All cheques should be crossed and made payable to **C. WORSFOLD, "NATURE" Office, St. Martin's Street, W.C.**

I enclose One Guinea as first payment for "NATURE'S Re-issue of the International Scientific Series," and I agree to pay to you, or your representative, the balance at the rate of One Guinea per month; my next payment to be on delivery of the volumes, and my remaining payments on the corresponding day of each month following.

Until such payments are complete, I engage that the Works, not being my property, shall not be disposed of by sale or otherwise.

I further agree that if it be found impossible for any reason to deliver the books, the return of the sum of One Guinea to me shall cancel this agreement.

Name.....

Address.....

Residents abroad are kindly requested to remit in full, or to instruct their representatives in England to make the monthly payments, in order to avoid the expense and delay in forwarding cash from abroad.

..The.. 'N. & G.' Cameras

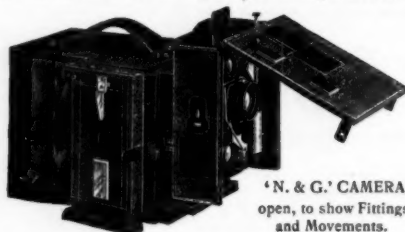
In all sizes up to 7 x 5 in.
For Plates, Cut Films, or Film
in Spools.

For hand and Tripod.

A Series of High-Class Instruments for Serious Work,
embodying every New Advance in Photography.

Prices from £13 to £50.

Have been in Constant Use for Eight Years in all parts of the World.



'N. & G.' CAMERA,
open, to show Fittings
and Movements.

TRIPOD CAMERAS, SURVEYING CAMERAS, and very Small and
Light POCKET CAMERAS for Travellers and Field Naturalists.

Speciality: COMPLETE OUTFITS for Scientific Expedi-
tions and Special Research.

Catalogues and Estimates. Lenses, Kinematographs, Lanterns, and all
free on application. Photographic Accessories and Materials.

Newman & Guardia, Ltd.
90 & 92 Shaftesbury Avenue, London, W.

CARL ZEISS, OPTICAL WORKS, JENA. ASTRONOMICAL DEPARTMENT.



Binary Apochromatic Telescope Object-Glasses, free from Secondary
Spectrum, for Visual purposes. Aperture from 1'17 to 1'20.

Triple Photo-Visual Object-Glasses, free from Secondary Spectrum and
Differences in Focus, for Observation and Photography. Aperture 1'10 to
1'15.

Apochromatic Aplanatic Object-Glasses, with reduced Secondary Spec-
trum, for Astro-Photography.

Achromatic Eye-Pieces, with long Eye-Distance.

Telescope Object-Glasses made of ordinary Silicate Glasses.

Objectives, Prisms, Eye-Pieces, and all Astronomical Accessories.

Complete Mounts for Telescopes in any desired form and size.

Special Astronomical Catalogue, in German, French or English,
free on application.

London Branch: 29 Margaret Street, Regent Street, W.

EVERETT & CO., MECHANICAL ENGINEERS AND ELECTRICIANS,

22 CHARTERHOUSE SQUARE, E.C.

Makers of High-Grade Physical and Electrical Apparatus.

Apparatus designed and made for Laboratories and Research Work.

ALL KINDS OF EXPERIMENTAL WORK

HIGH-CLASS WORKMANSHIP AND ACCURACY A SPECIALITY.

MODELS DESIGNED, &C.

REPAIRS OF EVERY DESCRIPTION.

OPPOSITE THE BRITISH MUSEUM.

THACKERAY HOTEL

(TEMPERANCE).

GREAT RUSSELL STREET, LONDON.

THIS newly-erected and commodious Hotel will, it is believed, meet the requirements of those who desire all the conveniences and advantages of the larger modern licensed hotels at moderate charges. Passenger Lift. Electric Light in all Rooms. Bath-rooms on every Floor. Spacious Dining, Drawing, Writing, Reading, and Smoking Rooms. All Floors Fireproof. Perfect Sanitation. Night Porter. Telephone. Bedrooms from 2s. 6d. to 4s. 6d. per night. Full Tariff and Testimonials on application.

Telegraphic Address: "THACKERAY, LONDON."

Proprietor—J. TRUSLOVE.

Also, amalgamated with, and under the same management,

ESMOND HOTEL

(TEMPERANCE).

MONTAGUE STREET, RUSSELL SQUARE.

THIS Hotel, which has been carried on so successfully for the last 13 years, adjoins the British Museum, and is exception-
ally quiet. Bedrooms from 2s. to 3s. 6d. per night. Full Tariff and Testimonials on application.

Telegraphic Address: "TRUSLOVE, LONDON."

Proprietor—J. TRUSLOVE.

TO SCIENTIFIC MEN, NATURALISTS, TRAVELLERS, AND OTHERS.

THE
LONDON
STEREOSCOPIC
Company

Pay
special
ATTENTION

To the details of Photographic Out-
fits for Scientific Men, Naturalists
Travellers, and others who require
the Apparatus to be exact in every
particular, and to be made on
Scientific lines. THE STEREO-
SCOPIC COMPANY also make
a speciality of Twin Lens Cameras,
and can show the largest Stock in
London of practical and highly-
finished Hand Cameras of every kind.



Extract of Letter from R. BOWDLER SHARPE, Esq., LL.D., Assist. Keeper Zoological Dept., British
Museum, March 4, 1898:—"I consider it one of the best day's work I ever did when I bought one of your Camera.
The ease with which it is worked, and the excellent results obtained, make it a most pleasurable accompaniment of
a summer's outing."

FREE LESSONS OR DEMONSTRATIONS TO PURCHASERS.

THE STEREOSCOPIC COMPANY,

108 and 108 REGENT STREET, W., and 54, Cheapside, E.C.

CATALOGUE FREE

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

NO. 1582, VOL. 61]

THURSDAY, FEBRUARY 22, 1900.

[PRICE SIXPENCE.

Registered as a Newspaper at the General Post Office.]

[All Rights are Reserved.

WIRELESS TELEGRAPHY.

The "APPS-NEWTON" INDUCTION COILS have proved far superior to all others in telegraphing long distances without wires.

They were used in the Government Experiments at Penarth and Dover; also by Signor Marconi and the Wireless Telegraph Company in telegraphing to and from the Goodwin Lightship, and across the Channel; at the British Association Meeting at Dover for telegraphing to France; and at the Naval Manœuvres, where a distance of sixty miles was covered, &c.

After prolonged tests the "Apps-Newton" Coils have been adopted by the Wireless Telegraph Company, by the War Office and by the Admiralty; several have been sent to the Front in South Africa, and the ships of the Channel Squadron are now being fitted with them.

PRICES ON APPLICATION.

SOLE MAKERS:

NEWTON & CO.,

Scientific Instrument Makers to H.M. the Queen
and the Government,

3 FLEET STREET, LONDON, E.C.

BECK'S

NEW

MICROSCOPE

THE

"BRITISH STUDENTS."

Microscope Stand No. 55, as figured, with Iris Diaphragm, One Eye-piece; Double Nose-piece, Two Object-glasses, 2/3" and 1/6", adjusted to be in about focus, and the whole packed in polished Mahogany Case.

£6 : 8 : 6

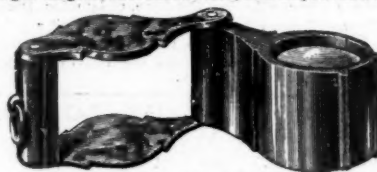


No. 55.

R. & J. BECK, Ltd.,
68 CORNHILL, LONDON, E.C.

BROWNING'S PLATYSCOPIC LENS.

With Larger Angles, Increased Field, and Improved Definition.



Engraved Real Size.

AN ACHROMATIC COMBINATION.

COMBINING THE DEFINITION OF A MICROSCOPE WITH THE PORTABILITY OF A POCKET LENS.

"If you carry a small Platyscopic Pocket Lens (which every observer of Nature ought to do)."—GRANT ALLEN in *Knowledge*.

The Platyscopic Lens is invaluable to botanists, mineralogists, or entomologists, as it focuses about three times as far from the object as the Coddington Lenses. This allows opaque objects to be examined easily.

The Platyscopic Lens is made of four degrees of power, magnifying respectively 10, 15, 20, and 30 diams.; the lowest power, having the largest field, is the best adapted for general use.

The Lenses are set in Ebonite Cells, and mounted in Tortoiseshell Frames.

Price of the Platyscopic Lens, mounted in Tortoiseshell, magnifying either 10, 15, 20, or 30 diameters, each power, 15s.

In nickel-plated German Silver, each power, 17s. 6d.

Illustrated Description sent free.

JOHN BROWNING, 63 STRAND, LONDON, W.C.

NEGRETTE & ZAMBRA'S

LONG RANGE BINOCULARS AND TELESCOPES

FOR MILITARY PURPOSES.

ILLUSTRATED PRICE LISTS FREE BY POST TO ALL PARTS OF THE WORLD.

SPECIAL TERMS TO YEOMANRY TROOPS AND VOLUNTEER CORPS REQUIRING SEVERAL GLASSES.



THE
"READY-FOCUS"
BINOCULAR.

A great improvement over the ordinary system of Focussing.

Invaluable in watching moving objects.

NEGRETTE & ZAMBRA,

SCIENTIFIC INSTRUMENT MAKERS TO THE QUEEN,

38 HOLBORN VIADUCT, E.C.

BRANCHES: 45 CORNHILL; 122 REGENT STREET.

THE DAVY-FARADAY RESEARCH LABORATORY

OF THE
ROYAL INSTITUTION.

DIRECTORS:

The Right Hon. LORD RAYLEIGH, M.A., D.C.L.,
LL.D., F.R.S.

Professor DEWAR, M.A., LL.D., F.R.S.

SUPERINTENDENT OF THE LABORATORY:

DR. ALEXANDER SCOTT, M.A., D.Sc., F.R.S.

This Laboratory was founded by Dr. Ludwig Mond, F.R.S., as a Memorial of Davy and Faraday, for the purpose of promoting, by original research, the development and extension of Chemical and Physical Science.

The Laboratory is open free of charge to Workers of either sex, and any nationality, prosecuting individual investigations; and the extensive collection of Physico-Chemical Apparatus presented by the Founder is available for their use, together with such materials, chemicals, electricity, &c., as the Directors may authorise.

Assistants and a trained mechanic are attached to the Laboratory to aid Workers in the prosecution of their researches.

All persons desiring to be admitted as Workers must send evidence of scientific training, qualification, and previous experience in original research, along with a statement of the nature of the investigation they propose to undertake.

Michaelmas Term.—Monday, October 2, to Saturday, December 16.

Lent Term.—Monday, January 8, to Saturday, April 7.

Easter Term.—Monday, April 30, to Saturday, July 28.

Forms of Application can be had from the ASSISTANT SECRETARY, Royal Institution, Albemarle Street, W.

BEDFORD COLLEGE, LONDON (FOR WOMEN),

YORK PLACE, BAKER STREET, W.

THE HALF-TERM BEGINS ON THURSDAY, FEBRUARY 22. Lectures are given in all branches of General and Higher Education. Students are prepared for all the University of London Examinations in Arts and Science.

A SINGLE COURSE OF LECTURES IN ANY SUBJECT MAY BE ATTENDED.

There is a Department for Professional Training in Teaching, and an Art School.

ENTRANCE SCHOLARSHIPS.

One Reid Scholarship in Arts, annual value £31 10s., tenable for three years; one Pfeiffer Scholarship in Science, annual value £48, tenable for three years, will be awarded on the results of the Examination to be held in June.

Particulars on application to the PRINCIPAL.

ROYAL INSTITUTION OF GREAT BRITAIN.

ALBEMARLE STREET, PICCADILLY, W.

THURSDAY next, MARCH 1, at three o'clock, CHARLES WALDSTEIN, Esq., Litt.D., Ph.D., L.H.D., Slade Professor of Fine Art in the University of Cambridge, First of Three Lectures on "Recent Excavations at the Argive Heraeum (in Greece)" (Illustrated by Lantern Slides). Half a Guinea the Course.

SATURDAY, MARCH 3, at three o'clock, the Right Hon. Lord RAYLEIGH, M.A., D.C.L., LL.D., Sc.D., F.R.S., M.R.I., Professor of Natural Philosophy, R.I., First of Six Lectures on "Polarised Light." One Guinea the Course.

BRITISH MUSEUM.

The Reading Rooms will be Closed from Thursday, March 1st, to Monday, March 5th, inclusive.

E. MAUNDE THOMPSON,
Director and Principal Librarian.

British Museum, February 21, 1900.

MATRICULATION, HOSPITAL SCHOLARSHIPS, &c.

PREPARATION BY CORRESPONDENCE AND ORAL TUITION on a THOROUGHLY INDIVIDUAL SYSTEM. Fees based on success. The STAFF includes Graduates of Oxford, Cambridge, London, and Royal Universities, Science Medallists, prizemen, Scholars, &c.

SINGLE SUBJECTS TAKEN: Latin, Greek, French, German, Mathematics, Science, Logic, Psychology, Political Economy, &c. For Terms, &c., address Mr. J. CHARLESTON, B.A. (Lond. and Oxon.), The Burlington Classes, 27 Chancery Lane, London, W.C.

BIRKBECK INSTITUTION,

Breams Buildings, Chancery Lane, E.C.

Science Classes with Practical Work.

DAY AND EVENING CLASSES for University of London B.Sc.; Prelim. Scientific, Inter. M.B. Examinations and for Conjoint Board, Dental and Pharmaceutical Examinations.

EVENING CLASSES in all stages for Science and Art Department Examinations.

HIGHLY-EQUIPPED LABORATORIES.

Chemistry, Physics, Biology (Zoology and Botany), Metallurgy, Geology and Mineralogy, Microscopy.

Prospectus free. Calendar 6d. (Post 8d.) on application to Secretary.

HEATHCOTE SCIENCE LABORATORIES.

These Laboratories are open for RESEARCH work, at any hours or times most convenient for worker, in CHEMISTRY, PHYSICS and BACTERIOLOGY. Facilities for Commercial investigations are supplied. Furnaces and powerful Electrical Currents can be used.

The Fees are at rate of £3 3s. for one month (five days a week, six hours a day). Apparatus supplied free.

Private Laboratory, £4 14s. 6d. a month, or by arrangement.

The above Fees include use of all ordinary Glass and other Apparatus, and use of Accurate Balances and Standard General Instruments, also Furnaces, &c.

9 Heathcote Street, Mecklenburgh Square, | R. C. T. EVANS,
Gray's Inn Road, W.C. | Director.

NATURAL SCIENCE SCHOLARSHIP.

KEBLE COLLEGE, OXFORD.

A SCHOLARSHIP of the annual value of £60, together with Laboratory Fees, not exceeding £20 per annum, will be awarded at this College in March 1900.

The Examination commences Tuesday, March 13.

Subjects: Chemistry or Biology, with Elementary Mechanics and Physics for all Candidates, and Elementary Chemistry for those who offer Biology.

For full particulars apply to W. HATCHETT JACKSON, Keble College, Oxford.

UNIVERSITY OF SOUTH WALES AND MONMOUTHSHIRE.

(A CONSTITUENT COLLEGE OF THE UNIVERSITY OF WALES.)

The Council invites applications for the Post of DEMONSTRATOR and ASSISTANT LECTURER in ANATOMY. Salary, £120.

Applications and testimonials, which need not be printed, should be sent on or before March 10th, 1900, to the undersigned, from whom further particulars may be obtained.

J. AUSTIN JENKINS, B.A.,
Secretary and Registrar.

Cardiff, 13th February, 1900.

THE RUSKIN UNION. Membership

Forms may be had from Mr. MARK H. JUDGE, Treasurer, 7 Pall Mall, or Rev. J. B. BOOTH, Hon. Sec., 48 The Albany, W.

AITKEN'S KONISCOPE, colour due to

Cloudy Condensation on Dust; Moist Chamber Glass Ends, Air Pump. Price reduced 63s. for 30s.—Posted, W. HUME, 1 Lothian Street, Edinburgh.

QUEEN'S COLLEGE, CORK.

The Professorship of Materia Medica in the Queen's College, Cork, being now Vacant, Candidates for that office are requested to forward their testimonials to the UNDER SECRETARY, Dublin Castle, on or before the 9th March, 1900, in order that the same may be submitted to the LORD LIEUTENANT.

Dublin Castle, 16th February, 1900.

CIVIL SERVICE COMMISSION. FORTHCOMING EXAMINATION.

DRAUGHTSMAN in the Hydrographic Department of the Admiralty (17-25), 13th March. Expertness in Hydrographical Chart Drawing essential.

The date specified is the latest at which applications can be received. They must be made on forms to be obtained, with particulars, from the SECRETARY, Civil Service Commission, London, S.W.

BARGAINS IN SCIENTIFIC BOOKS.

McALPINE (Prof. D.), BIOLOGICAL ATLAS—A GUIDE TO THE PRACTICAL STUDY OF PLANTS AND ANIMALS, adapted to the Requirements of the London University, Science and Art Department, and for Use in Schools and Colleges, containing 24 Plates, with 423 Coloured Figures and Diagrams, with Text giving Arrangement and Explanation, Equivalent Terms, Glossary, and Classification, Royal 4to, Half Cloth (7s. 6d.). 1s. 9d.

— **ZOOLOGICAL ATLAS, INVERTEBRATA** (including Comparative Anatomy), with Practical Directions and Explanatory Text, for the Use of Students. Containing 16 Plates, with 249 Coloured Figures and Diagrams, Oblong Folio, Half Cloth (9s.). 1s. 9d.

COLE, F.R.M.S. (A. C.), THE METHODS OF MICROSCOPICAL RESEARCH, A PRACTICAL GUIDE TO MICROSCOPICAL MANIPULATION. Second Edition, much Enlarged, 8vo, Cloth (6s.). 1s. 6d.

BRITTEN, F.L.S. (JAMES), EUROPEAN FERNS, THEIR FORM, HABIT AND CULTURE. with 30 Facsimile Coloured Plates, Painted from Nature by D. BLAIR, F.L.S., Demy 4to, Cloth (pub. 21s.). 7s.

NEWMAN, F.Z.S. (EDWARD), BRITISH BUTTERFLIES AND MOTHS. Illustrated with nearly 900 Life-size Figures of Species of Butterflies and Moths. Super Royal 8vo, Cloth, Gilt Edges (25s.). 12s.

Postage 5d. extra on one, or 7d. on two.

H. J. GLAISHER, New and Remainder Bookseller, 57 Wigmore Street, London, W.

Catalogues Post Free on application.

IN PREPARATION.
THE AUSTRALIAN MUSEUM, SYDNEY.
Monograph No. II.

NESTS AND EGGS OF BIRDS FOUND BREEDING IN AUSTRALIA AND TASMANIA.

By A. J. NORTH, C.M.Z.S.,
Ornithologist, Australian Museum.

With numerous Figures of Birds, and Plates of Nests, Eggs, and Breeding Places. To be Issued in Parts. PRICE 25s. COMPLETE.

Orders will be received at the Museum, or by Messrs. Angus & Robertson, Castlereagh Street, Sydney; Messrs. Turner and Henderson, Hunter Street, Sydney; Mr. E. W. Cole, George Street, Sydney; Book Arcade, Melbourne, and Rundle Street, Adelaide; Messrs. Melville, Mullen, and Slade, Melbourne; Messrs. R. Friedländer & Son, Berlin; Messrs. Kegan Paul, Trench, Trübner & Co., Paternoster House, Charing Cross Road, London; or any Booksellers.

NOW READY.
PHILOSOPHICAL TRANSACTIONS

OF THE
ROYAL SOCIETY OF LONDON.

Series A, containing Papers of a Mathematical or Physical character.
Vol. 193, with 28 Plates, Price £1 10s.

London: HARRISON & SONS, 45 St. Martin's Lane, W.C.

EVERETT & CO.,
MECHANICAL ENGINEERS AND
ELECTRICIANS,

22 CHARTERHOUSE SQUARE, E.C.

Makers of High-Grade Physical and Electrical Apparatus.
Apparatus designed and made for Laboratories and Research Work.

ALL KINDS OF EXPERIMENTAL WORK

HIGH-CLASS WORKMANSHIP AND ACCURACY A SPECIALTY.

MODELS DESIGNED, &C.

REPAIRS OF EVERY DESCRIPTION.

JUST OUT.

Demy 8vo, Uncut, Price 31s. 6d. net, by post 32s.

BRITISH DRAGONFLIES:

Being an Exhaustive Treatise on our Native Odonata; their Collection, Classification and Preservation.

By W. J. LUCAS, B.A., F.E.S.

Very fully illustrated with 27 Plates illustrating 39 Species, exquisitely printed in Colour, and numerous Black and White Engravings.

CRIES AND CALL NOTES OF WILD

BIRDS. A Popular description of the notes employed by our commoner British birds in their songs and calls. Illustrated by musical notation. By C. A. WITCHELL. 1s., by post 1s. 2d.

NATURALIST'S DIRECTORY for 1900.

Sixth year of issue. Invaluable to all Students and Collectors. 1s. 6d., by post 1s. 9d.

PRACTICAL TAXIDERMY. A Manual

of Instruction to the Amateur in Collecting, Preserving and Setting up Natural History Specimens of all kinds. By M. BROWNE, F.Z.S. 2nd Edition. 7s. 6d., by post 7s. 10d.

BOOK OF BRITISH HAWK MOTHS.

A Popular and Practical Manual for all Lepidopterists. Copiously illustrated from the Author's own exquisite drawings. By W. J. LUCAS, B.A. 3s. 6d., by post 3s. 9d.

VIVARIUM. Snakes, Lizards, and other

Reptiles, and How to Keep them in Confinement. By Rev. G. C. BATEMAN. Illustrated. 7s. 6d. net, by post 8s.

Full Catalogue on Application.

London: L. UPCOTT GILL, 170 Strand, W.C.

THE SCIENTIFIC ROLL AND MAGAZINE OF SYSTEMATIZED NOTES.

THIS WORK IS A VALUABLE

GUIDE, BIBLIOGRAPHY, AND INDEX TO SCIENCE.

In preparation.

BACTERIA (Botanical Section).

Although these are the simplest of plants, there is probably no group of organisms which exceeds them in interest or importance. Their operations affect the welfare of every member of the community, as also of the whole organic world. A full knowledge of them is essential in all questions bearing upon public and private health, agriculture, the microbial diseases of animals and of plants; and it is important in many industries, such as those dealing with milk, butter, hay, flax, tobacco, and others.

The group will be dealt with in three octavo volumes of about 500 pp. each. The subscription price will be 10s. for each volume, payable on delivery of the first number of the volume; or arrangements may be made to supply only the portions relating to a particular species, genus, or topic, at a proportionately reduced rate. The first volume will be commenced next summer, and if sufficient subscribers support the work, the three volumes will be completed in three years. As all the matter will be systematized, the series will be equivalent to a good bacteriological library, with the advantage that the information on any particular point will be comprised within a comparatively few pages, and not scattered over thousands of pages in a host of journals and books.

The names and addresses of subscribers, and applications for prospectus may be sent to the undersigned.

The undersigned will be glad to hear from PRINTERS willing to give estimates for printing, and from PUBLISHERS willing to consider terms for publishing the above-mentioned work.

A. RAMSAY,
4 Cowper Road, Acton, London, W.

SOTHERAN'S PRICE CURRENT OF LITERATURE.

No. 594, just published for February, includes a Special Collection of

WORKS IN NATURAL HISTORY.

MONTHLY LIST OF NEWLY PURCHASED SECOND-HAND BOOKS.

Post free from—

HENRY SOTHERAN & CO., Booksellers,
140 STRAND, W.C.; and 37 PICCADILLY, W.

MESSRS. LONGMANS & CO.'S SCIENTIFIC BOOKS.

JUST PUBLISHED. 8vo, 15s. net.

THE KINETIC THEORY OF GASES.

ELEMENTARY TREATISE, WITH MATHEMATICAL APPENDICES.

By Dr. OSKAR EMIL MEYER,

Professor of Physics at the University of Breslau. Second Revised Edition. Translated by ROBERT E. BAYNES, M.A., Student of Christ Church, Oxford, and Dr. Lee's Reader in Physics.

"There is no better book upon its subject, and English students owe a hearty welcome to a translation so thoroughly well done."—*Scotsman*.

"Without doubt the volume will find a place in the libraries of all who make physics and its allied subjects their study."—*Glasgow Herald*.

Complete in THREE VOLUMES, Half-Bound. Vol. I., with 236 Illustrations, 8vo, £2 2s. Vol. II., with 240 Illustrations, 8vo, £2 2s. Vol. III., with 352 Illustrations, 8vo, £3 3s.

A DICTIONARY OF APPLIED CHEMISTRY.

By T. E. THORPE, B.Sc. (Vict.), Ph.D., D.Sc. (Dubl.), F.R.S.,

Professor of Chemistry in the Royal College of Science, London. Assisted by Eminent Contributors.

THE PRINCIPLES OF CHEMISTRY. By D. MENDELÉEFF. Translated from the Russian (Sixth Edition) by GEORGE KAMENSKY, A.R.S.M. of the Imperial Mint, St. Petersburg; and Edited by T. A. LAWSON, B.Sc., Ph.D., Fellow of the Institute of Chemistry. With 96 Diagrams and Illustrations. 2 Vols., 8vo, 36s.

A TEXT-BOOK OF INORGANIC CHEMISTRY. By G. S. NEWTH, F.I.C., F.C.S., Demonstrator in the Royal College of Science, London; Assistant Examiner in Chemistry, Science and Art Department. Fifth Edition. With 146 Illustrations. Crown 8vo, 6s. 6d.

CHEMICAL ANALYSIS, QUANTITATIVE AND QUALITATIVE. By G. S. NEWTH, F.I.C., F.C.S., Demonstrator in the Royal College of Science, London; Assistant Examiner in Chemistry, Science and Art Department. With 100 Illustrations. Crown 8vo, 6s. 6d.

GANOT'S ELEMENTARY TREATISE ON PHYSICS, EXPERIMENTAL AND APPLIED. Translated and Edited from Ganot's "Éléments de Physique," by E. ATKINSON, Ph.D., F.C.S. FIFTEENTH EDITION. Revised and Enlarged. With 9 Coloured Plates, 1057 Illustrations in the Text, and an Appendix of Problems, with Answers. Crown 8vo, 15s.

GANOT'S NATURAL PHILOSOPHY FOR GENERAL READERS AND YOUNG PERSONS. Translated and Edited from Ganot's "Cours Élémentaire de Physique," by E. ATKINSON, Ph.D., F.C.S. EIGHTH EDITION. With 7 Plates, 624 Illustrations in the Text, and an Appendix of Questions. Crown 8vo, 7s. 6d.

A TEXT-BOOK OF PHYSICS. By W. WATSON, B.Sc., Assistant Professor in Physics in the Royal College of Science, London; Assistant Examiner in Physics, Science and Art Department. For use in Technical Schools, Advanced Science and Art Classes, Engineering Schools, Universities, &c., &c. With 564 Illustrations. Large Crown 8vo, 10s. 6d. [Just published.]

ELECTRICAL ENGINEERING. For Electric Light Artisans and Students. (Embracing those branches prescribed in the Syllabus issued by the City and Guilds Technical Institute.) By W. SLINGO and R. BROOKER. ENLARGED AND REVISED EDITION. With 359 Illustrations. Crown 8vo, 12s.

THE TESTING OF MATERIALS OF CONSTRUCTION. A Text-book for the Engineering Laboratory and a Collection of the Results of Experiment. By WILLIAM CAWTHORNE UNWIN, F.R.S., M.Inst.C.E., Hon. M.Inst.M.E., Professor of Engineering at the Central Technical College of the City and Guilds of London Institute. SECOND EDITION, REVISED AND ENLARGED. With 5 Plates and 188 Illustrations and Diagrams in the Text. 8vo, 16s. net.

RIVINGTON'S COURSE OF BUILDING CONSTRUCTION.

NOTES ON BUILDING CONSTRUCTION. Arranged to meet the Requirements of the Syllabus of the Science and Art Department of the Committee of Council on Education, South Kensington. Medium 8vo.

PART I. ELEMENTARY STAGE. With 552 Illustrations. 10s. 6d.

PART II. ADVANCED STAGE. With 479 Illustrations. 10s. 6d.

PART III. MATERIALS. Course for Honours. With 188 Illustrations. 21s.

PART IV. CALCULATIONS FOR BUILDING STRUCTURES. Course for Honours. With 597 Illustrations. 15s.

LONGMANS, GREEN, & CO., LONDON, NEW YORK, AND BOMBAY.

ONLY ONE WEEK MORE.

It will be necessary to withdraw the *Standard's* Remarkable Offer of THE LIBRARY OF FAMOUS LITERATURE at the present Introductory Prices within a Few Days. Meanwhile the *Standard* will send, Post Paid upon application, a 100-Page Illustrated Prospectus of THE LIBRARY. But the number of Prospectuses is necessarily limited because of the Great Demand for them. Intending Subscribers who wish to read

THE FULL STORY OF THIS GREAT WORK SHOULD MAKE APPLICATION AT ONCE.

Never in the world was it so true as it is to-day that "time is money." The expenditure of vast sums, the collaboration of the greatest men of the age, the influence of a great newspaper, have all combined to achieve two results.

FIRST.—All the best reading to be found in the million best books have been selected and edited, and, in many cases, translated, in order to make the *Standard's* LIBRARY OF FAMOUS LITERATURE twenty handsome volumes.

SECOND.—An edition of ten thousand copies of this unequalled work has been, by virtue of a special and temporary arrangement, offered to the ten thousand purchasers who first apply, at half the regular price.

This special price is not for a cheap edition. The same paper, the same broad margins, the same coloured plates and exquisite engravings, the same sumptuous bindings, are offered now for half price, and will afterwards be obtainable by those persons only who can afford to pay the full price. Such an opportunity as this attracts the attention of every alert-minded man.

The public have shown that they are alert. Although the offer has not long been before the world of book buyers, more than eight thousand people have already purchased THE LIBRARY. Only two thousand sets remain, and these will be taken up even more

swiftly than were the others, for THE LIBRARY is now being advertised as no book has ever before been advertised. Every one who can make up his mind within the next three or four days may be sure of procuring a copy.

That is how the matter stands to-day. But you are not asked to make up your mind to-day. All you need do now is to cut out the "Application for Prospectus," which will be found at the lower right-hand corner of this page, and send it to the *Standard's* Office. By the next day's post there will go to you free of charge, safely enclosed, by prepaid letter post,

A HANDSOME 100-PAGE PROSPECTUS,

FULL OF ILLUSTRATIONS OF THE NEW LIBRARY OF FAMOUS LITERATURE, Edited by Dr. RICHARD GARNETT, C.B.

It will take you an hour to read these specimen pages. When you have read them and considered the details of the special offer which accompanies them, you will be in a position to decide; you will have seen what the book is and what the bargain is, and if you then lose no more time, but send your order promptly to the *Standard*, accompanied by a cash payment of only half a guinea, you will not be among the belated and disappointed persons who wait until it is too late.

There is just time to do this, there is no margin for delay. "Time is money."

ABOUT THE PROSPECTUS.

Upon the receipt of a request, stating where this announcement appeared, the *Standard* will send, post paid, a handsome one-hundred-page Illustrated Prospectus, which is referred to at the top of this page. Note what it is and what it contains. Its pages are, to begin with, of the same size as the pages of THE LIBRARY; they are set in the same type and printed on the same kind of paper. There are, moreover, facsimile reproductions of thirty pages from THE LIBRARY itself. The contents of the Prospectus comprise:

1. A prospectus in brief, a concise description of THE LIBRARY in forty lines.
2. A facsimile of the curious Greek manuscript of an oration of Demosthenes which forms the frontispiece of Volume I. of THE LIBRARY.
3. A series of twenty pictures of Dr. Garnett and the famous men of letters who have made THE LIBRARY OF FAMOUS LITERATURE.
4. What this great LIBRARY is (four pages).
5. Why THE LIBRARY has come into existence (resuming a part of Dr. Garnett's introduction to THE LIBRARY).
6. What THE LIBRARY contains (six pages).
7. From celebrated men of letters (telling of the eminent men who have contributed to the making of THE LIBRARY).
8. The illustrations and some technical details (as to the bindings, coloured plates, indexes, &c.).
9. Specimens of the rare and quaint coloured plates which illustrate each volume of THE LIBRARY.
10. Thirty specimen pages from THE LIBRARY itself.
11. Three pages from the two large Indexes, General and Topical, included in the last volume of THE LIBRARY (which occupy seventy pages in full).
12. Seventeen full-page illustrations from among the five hundred full-page illustrations which illustrate THE LIBRARY (these include reproductions of celebrated paintings, portraits of authors, their homes, and the like).

This large pamphlet is sent to any one who will ask for it, without charge.

LETTERS FROM SUBSCRIBERS.

I FIND IT QUITE UP TO WHAT YOU'VE ADVERTISED.

Seaton House, Wembley, Middlesex.
I received yesterday THE LIBRARY OF FAMOUS LITERATURE. I am very pleased with it, and I find it quite up to what you advertised.

EDWARD W. WOOD.

ALL THAT WAS REPRESENTED IN THE PROSPECTUS.

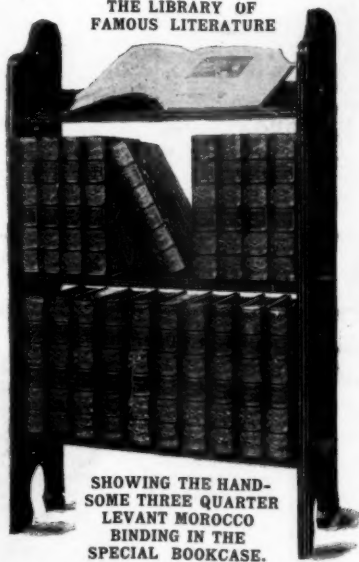
Gijón, Spain.
THE INTERNATIONAL LIBRARY OF FAMOUS LITERATURE has been received. It is a compendious treasure for every busy man—more so to one

SPECIAL INTRODUCTORY OFFER. (NOW ABOUT TO BE WITHDRAWN.)

Those who subscribe now, in advance of publication, may obtain the Complete Work, Twenty Volumes, AT A REDUCTION OF FIFTY PER CENT. from the regular prices hereafter to prevail. THE LIBRARY is not sold in parts or by single volumes, but only in complete sets. The entire Twenty Volumes will be sent, all at one time, upon a preliminary payment of but HALF-A-GUINEA; further payments, after the Twenty Volumes are in your home, to be at the rate of 9, 12, 15, or 21 shillings per month, according to the binding.

A tasteful and convenient bookcase will be supplied to subscribers at a low price.

THE LIBRARY OF FAMOUS LITERATURE



situated as I am—far from the reach of any library or centre where there are facilities for reference.

In the cursory examination that I have been able to make, I find it to be all that is represented in the Prospectus, and it will afford me infinite pleasure to have at all times within reach the possibility of being in touch with the literary master-minds that the world has produced.

J. A. JONES.

JUSTIFY THE HIGH PROMISES HELD OUT IN THE PROSPECTUS.

Harrington.

I have to acknowledge delivery of THE LIBRARY OF FAMOUS LITERATURE, all in good order, a few days ago. I think it only just to the Editors and Publishers to express my entire satisfaction with the volumes. I consider they amply justify the high promises held out in the Prospectus, and I wish them all the success they well deserve.

By all who have a taste for the best forms of literature, whether old or young, rich or poor, they cannot fail to be highly valued; while to one who, like myself, is getting on towards the "evening of life," I cannot think of anything more likely to be a solace and a pleasure, gathering up, as it were, so many of the buried treasures that one loved in past years, besides presenting such a wealth of some of the finest products of the human intellect, which it would be impossible for an ordinary mortal to know anything about, except by such an anthology as this.

A. B. MORGAN.

A SHORT CUT TO CULTURE.

17, St. John's Road, Eastbourne.

THE LIBRARY came safely to hand. It affords a wealth of reading for a man in years as well as for a young man in years.

—a short cut to culture for the young unable to give their whole lives to the study of books in a complete form. E. HARCOURT BURRAGE.

SHOULD OBTAIN THE LIBRARY BY THE ADVERTISED SYSTEM OF MONTHLY PAYMENTS.

"Stelvio," Bassalleg Road, Newport, Mon.

I was more than gratified when I received the full Morocco Bound LIBRARY OF FAMOUS LITERATURE. I was delighted at the outside appearance, and very much so at the inside. The style and choice of authors is thoroughly good. I feel I have many pleasant hours before me in the perusal of the volumes.

To those who cannot spare cash down, and they want a "good thing," my advice is to obtain THE LIBRARY OF FAMOUS LITERATURE by your advertised system of monthly instalments.

Tyne Engine Works, Newport.

CHARLES H. BAILEY.

INQUIRY FORM FOR THE 100-PAGE PROSPECTUS.

If you do not wish to cut this slip out, carefully state that you saw this notice in *Nature*, otherwise the Prospectus cannot be sent.

W. M. JACKSON, THE STANDARD,

23 St. Bride Street, E.C.

.....1900.

Having read in *Nature* your offer regarding the LIBRARY OF FAMOUS LITERATURE, I request that you send me your Illustrated Prospectus.

Name.....

Address.....

DINES' PATENT PRESSURE PORTABLE ANEMOMETER.



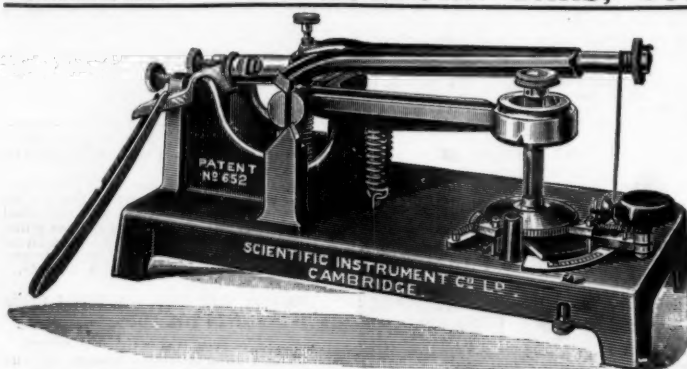
For many years the want has been felt of a PORTABLE ANEMOMETER, by means of which the actual Velocity and Pressure of the Wind could be quickly ascertained. This want Mr. W. DINES, who is well known for his anemometrical experiments, has met by his PATENT PRESSURE PORTABLE ANEMOMETER.

One scale of the instrument shows *directly* the actual velocity of the wind; the other (not shown in the woodcut) the pressure exerted in pounds per square foot. The instrument is used vertically, with the nozzle pointing towards the wind.

FULL PARTICULARS SENT ON APPLICATION.

PRICE £3 10 0

L. CASELLA,
SCIENTIFIC INSTRUMENT MAKER TO THE ADMIRALTY AND ORDNANCE,
Telegraphic Address "SCOUTKRON, LONDON." 147 HOLBORN BARS, LONDON, E.C. Telephone, "1864 Holborn."



THE CAMBRIDGE
SCIENTIFIC INSTRUMENT CO.
Ltd., CAMBRIDGE.

NEW ROCKING MICROTOME. 1900 PATTERN. [PATENTED.]

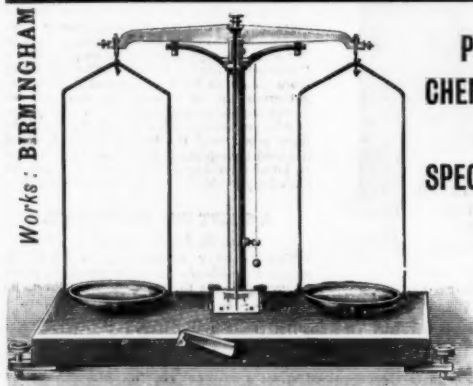
This Instrument possesses the following great improvements over the old type of instruments:—
(1) Increased rigidity. (2) The impossibility of cutting thin and thick sections. (3) The impossibility of tearing sections on the upward movement of the object. (4) A graduated arc for showing the thickness of the sections. (5) Catch for holding the object above the edge of the razor. (6) Improved method of fixing the cord. (7) A new object holder.

PRICE (including object holder), £5 0 0

Write for Pamphlet descriptive of the above Instrument.

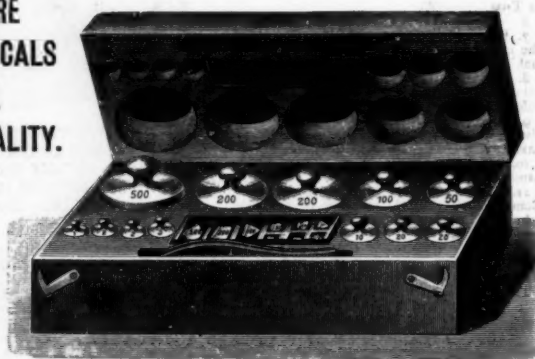
Address all communications:—
INSTRUMENT COMPANY, CAMBRIDGE.

EXTRAORDINARY VALUE.



Works: BIRMINGHAM

PURE
CHEMICALS
A
SPECIALITY.



100 GRAMME BALANCE

Of VERY BEST FINISH, with

AGATE KNIFE EDGES & BEARINGS,
BEAM SUPPORT, LEVELLING SCREWS,
PLUMB LINE, EXTRA HOOKS.
SENSITIVE to 1 MILLIGRAMME.

£1 : 9 : 6.

W. & J. GEORGE, Ltd., late

F. E. BECKER & CO., 33-37 HATTON WALL, LONDON.

COMPLETE SET OF WEIGHTS

IN POLISHED
BOX.

4s.

100 Grammes to
1 Milligramme.

COMPLETE LABORATORY FURNISHERS AND MANUFACTURERS
OF CHEMICAL, PHYSICAL, AND BACTERIOLOGICAL APPARATUS,
INCLUDING THE CELEBRATED "NIVOC" SPECIALITIES.

CATALOGUES ON APPLICATION.

ISENTHAL, POTZLER & CO.,

85 MORTIMER STREET, LONDON, W.

Telegrams: "HYSTERESIS."

Telephone: 2099, GERRARD.

CENTRAL DEPOT FOR RADIOGRAPHERS.



INDUCTION COILS OF HIGH EFFICIENCY.

Write for Lists, or better inspect our Installations.
HIGHEST REFERENCES.

EVERYTHING NOVEL & ORIGINAL.

Sole Agents for Scotland:

Messrs. JAMES WHITE, Cambridge Street, Glasgow.

NEW SCIENCE LANTERN.

SOLE MAKERS
REYNOLDS & BRANSON,
Ltd.

IMPROVED
PORTABLE
DESIGN.



The Universal Science Lantern has been devised for the projection of experiments. In the short box in front of the lantern is a hinged mirror, so placed that by the movement of a stud it may be introduced and placed at an angle of 45 degrees with the parallel beam. The beam is thus sent upwards through a horizontal convergent lens, on which a slide or horizontal piece of apparatus can be placed. Above this is the objective mounted on a brass pillar, and above the objective a prism or mirror (if the screen is elevated above the lantern plain prisms are required for each beam), silvered on the outside so that there is no double reflection. The mirror can be adjusted to any angle, and is intended to send the image in an approximately horizontal direction to the screen. Slides can also be directly projected in the usual way.

The base-board is made to fold so that the lantern can be packed into a box 18½ x 8½ x 20½ with all its accessories *in situ*.

Price Complete, in Travelling Box, £9 0 0

REYNOLDS & BRANSON, LTD.
14 COMMERCIAL STREET, LEEDS.

A. HILGER,

204 Stanhope Street, Hampstead Road, London, N.W.

POCKET SPECTROSCOPES.

Direct Vision Pocket Spectroscopes, with or without
COMPARISON PRISM and PHOTOGRAPHIC SCALE; for
PHYSIOLOGICAL, CHEMICAL, and RAINBAND observations, &c.

FILM REPLICAS OF ROWLAND DIFFRACTION GRATINGS,
14,438 LINES PER INCH, mounted

- (1) On Worked Plate Glass. Price 18s. 6d.
- (2) On Plane Parallel Plates of Worked Optical Glass.
Price £2 2s. 6d.
- (3) In Pocket Spectroscopes (giving a spectrum of over 20°, and distinctly dividing the D lines). Price from £3.
- (4) Adapted to Field Glasses for Eclipse Observations.

Spectroscopes for any purpose; and every kind of
Spectroscopic Accessory.

WRITE FOR PRICE LIST OF SPECTROSCOPES.

CARL ZEISS,

MANUFACTURER OF

MICROSCOPES; TELESCOPES (ASTRONOMICAL
and TERRESTRIAL); PRISM FIELD GLASSES;
TELEMETERS; PHOTOGRAPHIC OBJECTIVES;
and OPTICAL MEASURING INSTRUMENTS,
including COMPARATORS, REFRACTOMETERS,
BUTTER-REFRACTOMETERS, SPECTRO-
METERS, &c.

LONDON BRANCH:

29 MARGARET ST., CAVENDISH SQUARE, W.

Telegrams:—DIACINIC, London.

CATALOGUES POST FREE. KINDLY SAY WHICH REQUIRED.

OBSERVATIONS AND - - -

SCIENTIFIC INVESTIGATIONS

Can be performed easily
and quickly, and impor-
tant facts and deductions
neatly and legibly re-
corded, with the aid of a
Writing Machine. The
one that will enable the
Scientist to obtain the
best results, and give
him the greatest satisfac-
tion, is undoubtedly that
Marvel of Mechanical
Skill,



THE
YOST
TYPE-
WRITER.

For full particulars of this wonderful Instrument, send
for Illustrated "E" Catalogue to

The YOST TYPEWRITER Co., Ltd.,
50 HOLBORN VIADUCT,

London, E.C.

WEST END DEPOT:—303 Oxford Street.

Now Ready, 8vo, Price 6s. net.

RECENT & COMING ECLIPSES.

BY

SIR NORMAN LOCKYER, K.C.B., F.R.S.

Second Edition, containing an account of the observations made at Viziadrug, in India, in 1898, and of the conditions of the Eclipses visible in 1900, 1901 and 1905.

MACMILLAN AND CO., LTD., LONDON.

WATKINS & DONCASTER,

NATURALISTS,
AND MANUFACTURERS OF

CABINETS AND APPARATUS

FOR ENTOMOLOGY, BIRDS' EGGS, AND ALL BRANCHES OF
NATURAL HISTORY.

SPECIAL SHOW-ROOM FOR CABINETS.

Call or send for detailed Catalogue (66 pp.), Post free on application.

N.B.—For Excellence and Superiority of Cabinets and Apparatus, references are permitted to distinguished patrons, Museums, Colleges, &c.

A LARGE STOCK OF INSECTS AND BIRDS' EGGS.

Birds, Mammals, &c., Preserved and Mounted by First-class Workmen with true natural surroundings. All Books and Publications on Natural History supplied.

36 STRAND, LONDON, W.C.

(Five Doors from Charing Cross.)

PHYSIOGRAPHY and GEOLOGY.

COLLECTIONS & MICROSCOPIC SLIDES,

As advised by Science and Art Directory, arranged by

JAMES R. GREGORY & CO.,
Mineralogists, &c.,

To Science and Art Department, British, Indian and Colonial
Museums, &c.

NOVELTIES and RARE GEMS and PRECIOUS STONES.

Mineral Specimens for Museums, and Collectors, and all purposes.
Rock Specimens and Microscopic Sections of Rocks and Minerals
cut to order.

NEW AND VALUABLE MINERAL SPECIMENS CONSTANTLY
ARRIVING.

Stores & Offices: 1 Kelso Place, KENSINGTON, W.

NEW CATALOGUES AND LISTS FREE.

MINERALOGY.

Micro. Slides, Collections and Single Specimens of Minerals, Rocks and Precious Stones, for the Student, Teacher and Prospector.
Elementary Collections in Case, 40 Specimens in Case, 6s. Blowpipe Cases and all necessities for Field or Class Work.

LESSONS GIVEN.

SAMUEL HENSON,

97 REGENT STREET, LONDON, W.

ESTABLISHED 1840.

BORD'S PIANOS

BECHSTEIN PIANOS

25 per cent. Discount for Cash, or 14/6 per month (second-hand, 10/6 per month) on the Three Years' System. Lists free of

C. STILES & CO., 40 & 42 Southampton Row, London, W.C.
PIANOS EXCHANGED.

These magnificent Pianos for Hire on the Three Years' System at advantageous prices and terms. Lists and particulars free of
CHAS. STILES & CO., 40 & 42 Southampton Row, LONDON, W.C.

LETCHER & SONS (formerly Letcher Bros.),
SCIENTIFIC INSTRUMENT MAKERS,
25 TURNPIKE LANE, HORNSEY, N.

BLOWPIPE CABINETS. SPECIALITY: SOCIETY OF ARTS SETS.

T. TAMBLYN-WATTS, SCIENTIFIC APPARATUS MAKER.

Catalogue of Electrical Apparatus and Materials, 6d. Post free.
Catalogue of Balances and Weights, Apparatus for the Study
of Mechanics, &c., 6d. Post free.

GOLDIELANDS, SETTLE, YORKS.

SECOND-HAND MICROSCOPES

By SWIFT, WATSON, CROUCH, BECK, ZEISS, LEITZ, &c.
Prices from £2 10s. to £45.

A Large Selection of Second-hand Powers and Fittings for all kinds of
Microscopes.

Send for New List.

CLARKSON & CO., 28 Bartlett's Buildings, Holborn Circus, E.C.

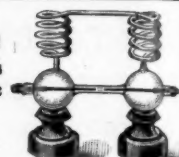
GLASS BLOWING.

All kinds of Experimental Glass
Blowing carried out for Scientific
Men, Laboratories, &c.

INVENTORS' IDEAS WORKED OUT AS PER INSTRUCTIONS.

COSSOR,

67 Farringdon Road, E.C.



Hittorf's Tube showing the
resistance of the dark space.

TO SCIENCE LECTURERS.

HUGHES' MOTO-PHOTOSCOPE FOR LIVING PICTURES.

THE MOST PERFECT.

No SHUTTER, therefore no Flickering. Superb Mechanism.
The Moto-Photo Camera for taking the Pictures. Illustrated Lists, sd.
See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN, &c.
Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great success. New Oxyhydrogen Microscope. Science Lanterns for Class Demonstration. Magnificent Results. Docwra Triple, Prize Medal Highest Award. Supplied to the Royal Polytechnic Institution, Dr. H. GRANT GUINNESS, Madame ADELINA PATTI, &c., &c. Patent Pamphengo, Science Lanterns. The Universal Lantern 4-inch Condensers, 4-wick Lamp. Portrait Combination front Lenses, 18s. 6d., Marvellous value. Science Lecture Sets. Novelties. The Lantern Kaleidoscope. Cheapest Lantern Outfits in the World. Grandly Illustrated Catalogue, over 180 choice Engravings, 6d.; Postage, 3d. List of 300 Lecture Sets, Science Subjects, Views, &c., 6d.; Postage, sd. Pamphlets Free. W. C. HUGHES, SPECIALIST, Brewster House, 82 Mortimer Road, Kingsland, N.

MINERALS, ROCKS & FOSSILS.

COLLECTIONS FOR STUDENTS.

Carefully labelled and arranged in Boxes with Card Trays.

50 Minerals, 12/6; 100 do., 21/; 200 do., 42/-.

Rocks and Fossils at similar prices.

300 Minerals in Cabinet, £4 4s.; 400 do., £5 12s. 6d.

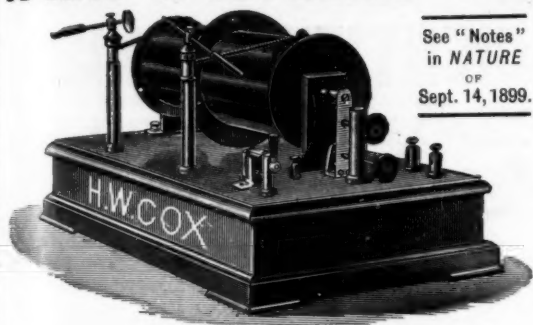
Catalogues Post Free.

THOMAS D. RUSSELL,

78 NEWGATE STREET, LONDON, E.C.

PRO
STUD

X-RAY & ÆTHERIC TELEGRAPHY APPARATUS



See "Notes"
in NATURE
OF
Sept. 14, 1899.

OF THE HIGHEST QUALITY AND FINISH ONLY,
As supplied by us to H.M. Government and the leading
Hospitals and X-Ray Workers throughout the World.

We are the actual Manufacturers, and Guarantee
every Coil against breaking down.

CALL OR WRITE FOR OUR NEW ILLUSTRATED LIST, WITH
TESTIMONIALS AND ILLUSTRATED INSTRUCTIONS UPON HOW
TO WORK. POST FREE TO READERS OF "NATURE."

HARRY W. COX, Ltd.,
10, 11, 28 CURSITOR STREET,
CHANCERY LANE, LONDON.

Radiographs taken for Scientific and Medical Men, and
Demonstrations given.

MOORE'S HYDROSTATIC BALANCE

FOR ILLUSTRATING THE "PRINCIPLE OF
ARCHIMEDES" AND SPECIFIC GRAVITY.

A is a delicate spring balance accurately graduated to
read Grams, and is capable of being lowered or raised
by the string shown.

B is one of the set of cubes of various metals supplied
with the apparatus.

C is a glass vessel with fixed mark etched in glass, up
to which water, or other liquid, is placed. The
vessel is provided with draw-off cock.

Sole Makers of this Apparatus—

BREWSTER, SMITH, & CO.,
6 CROSS STREET, FINSBURY, E.C.

Manufacturers and Importers of Chemical and Scientific
Apparatus and Pure Chemicals.

WEIGHTS a Speciality, 500 Milligrams to
1 Milligram, 1s. 6d. per doz.

SEND FOR COMPLETE ILLUSTRATED
CATALOGUE.



Apparatus for estimation of sulphur in spent oxide.

FREDK. JACKSON & Co.

(Late MOTTERHEAD & CO.),

14 CROSS STREET, MANCHESTER.

Goods Entrance: 10 Half-Moon Street,

LABORATORY FURNISHERS,
Importers, Manufacturers, and Dealers in
**CHEMICAL AND PHYSICAL
APPARATUS**

Of every Description.

Fine Chemicals, Volumetric Solutions,
Plain and Stoppered Bottles,

AND EVERY LABORATORY REQUIREMENT.
Illustrated Catalogue of Apparatus, with Price List
of Chemicals, free on application.

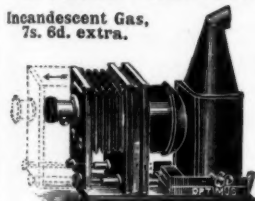
Telegraphic Address—"APPARATUS, MANCHESTER."

Telephone Number—2038.



"OPTIMUS" CANTILEVER PHOTOGRAPHIC ENLARGER.

Incandescent Gas,
7s. 6d. extra.



This already popular model
is finished in a very superior
and practical style. The lamp
gives a brilliant and even light.
The optical system is through-
out the best. The Lens will
be found to give a very flat
field and good marginal defini-
tion.

* SUITED FOR POCKET
CAMERA NEGATIVES.

Diam. of Condenser	4in.	5in.	6in.	8in.	10in.
Price, no Front Lens	62/-	70/-	80/-	110/-	200/-
Extra for Front Lens	27/-	27/-	37/-	63/-	63/-
Covering Plates	34x34	44x34	64x44	84x54	104x54

Catalogue POST FREE.

PERKEN, SON & CO.,

"OPTIMUS" MAGIC LANTERNS

FOR DRAWING ROOM
AND LECTURE HALL

Each Lantern is efficient for Exhibitions.
The Lens gives crisp definition, being a
superior Achromatic Photographic Combination,
with Rack and Pinion, compound Con-
denser of 4-in. diameter. Each has 3-wick
Refracting Lamp, and is Complete in box.
(4-wick Lamp, 2s. extra.)



Mahogany outside Body, Panelled Door,
Brass Stages, and 3-draw Sliding Tubes, so
that lenses of long focus may be used when
projecting upon a screen at a great distance, £5 5s.

Mahogany outside Body, lined with metal, making a
thoroughly practical instrument, and really good value ... £2 12 0

Russian Iron Body, Brass Sliding Tubes (Educational)... 3 3 0

Do. do. (College) ... 2 8 0

99 HATTON GARDEN,
HOLBORN CIRCUS, E.C. **LONDON.**

HARVEY & PEAK

(BY APPOINTMENT TO THE ROYAL INSTITUTION OF GREAT BRITAIN)

HAVE FOR DISPOSAL A NUMBER OF

NICOL PRISMS AND TOURMALINES of various Sizes.

PROJECTION POLARISCOPES of various Sizes in Stock, with large Nicol Prisms:—

STUDENTS' SPECTROMETERS.—P. O. Bridge Sets, for Schools.—Induction Coils.—Wimshurst Machines.—
X-Ray Apparatus.—Optical Banks, &c., &c.

H. & P. are the actual Manufacturers of the above.

56 CHARING CROSS ROAD, LONDON, W.C.

NOTICE.—SPECIAL RE-ISSUE BY NATURE
OF THE
INTERNATIONAL SCIENTIFIC SERIES
FOR A STRICTLY LIMITED PERIOD.

EIGHTY-SIX VOLUMES.

**A COMPLETE LIBRARY OF SCIENCE AT
A GREATLY REDUCED PRICE.**

PUBLISHERS' PRICE	...	...	...	...	£21 10 0
BY INSTALMENT (TO-DAY)	...	...	...	...	£14 14 0
FOR CASH	...	...	...	...	£13 10 0

The "International Scientific Series" has a world-wide reputation, and is to be found in every well-equipped Library throughout the English-speaking world. No more generous or acceptable present could be made to any Public Library or individual than this magnificent Encyclopædia of Scientific Research.

Most of the works are illustrated, and many with beautiful coloured plates. The Series has been contributed to by men of science of the highest eminence, such as Tyndall, Herbert Spencer, Walter Bagehot, Alexander Bain, Stanley Jevons, Huxley, Sir John Lubbock, G. J. Romanes, Balfour Stewart, Sir Norman Lockyer, Draper, Bonney, Sir Hubert Parry, Sir E. Maunde Thompson. This list only professes to convey a slight idea of the attention that has been given to the whole Series by the selection of only the best writers to deal with the various subjects considered.

This special offer is open only for a short time, and intending purchasers will do well therefore to send their orders without delay.

For the benefit of those who do not feel disposed to buy the entire Series, it will be possible to secure half the Series, making 43 volumes, for £7 cash, or £7 7s. on the instalment system, the purchaser himself selecting the volumes. The whole Series or half, as the case may be, will be sent on receipt of the first payment of One Guinea—the rest to be paid at the rate of £1 1s. per month.

NOTE:—OFFER OPEN ONLY FOR A SHORT TIME.
ORDER AT ONCE.

A Set of the Volumes may be seen at the Office of NATURE, ST. MARTIN'S STREET, W.C.

A Pamphlet, giving titles, &c., of the Works in the Series, Specimen Pages, with Illustrations, of some of the Volumes, also Order Form, will be sent Post Free on application to

C. WORSFOLD, "NATURE" Office, St. Martin's Street, London, W.C.

ORDER FORM.

Date.....1900.

All cheques should be crossed and made payable to C. WORSFOLD, "NATURE" Office, St. Martin's Street, W.C.

I enclose One Guinea as first payment for "NATURE'S Re-issue of the International Scientific Series," and I agree to pay to you, or your representative, the balance at the rate of One Guinea per month; my next payment to be on delivery of the volumes, and my remaining payments on the corresponding day of each month following.

Until such payments are complete, I engage that the Works, not being my property, shall not be disposed of by sale or otherwise.

I further agree that if it be found impossible for any reason to deliver the books, the return of the sum of One Guinea to me shall cancel this agreement.

Name.....

Address.....

Residents abroad are kindly requested to remit in full, or to instruct their representatives in England to make the monthly payments, in order to avoid the expense and delay in forwarding cash from abroad.

PHŒNIX FIRE OFFICE,

19 LOMBARD ST., E.C., and 57 CHARING CROSS, S.W.

ESTABLISHED 1782.

MODERATE RATES. ABSOLUTE SECURITY.

ELECTRIC LIGHTING RULES SUPPLIED.

LIBERAL LOSS SETTLEMENTS.

PROMPT PAYMENT OF CLAIMS.

FRANCIS B. MACDONALD, SECRETARY.

LOSSES PAID OVER £22,000,000.

ESTABLISHED 1851.

BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

INVESTED FUNDS

£10,000,000.

The BIRKBECK ALMANACK, with full particulars, post free.

FRANCIS RAVENSCROFT, Manager.

LIVING SPECIMENS FOR THE MICROSCOPE.

Volvox, Spirogyra, Desmids, Diatoms, Amœba, Arcella, Actinosphaerium, Vorticella, Stentor, Hydra, Floscularia, Stephanoceros, Melicerta, and many other Specimens of Pond Life. Price 1s. per Tube, Post Free. Helix pomatia, Astacus, Amphioxus, Rana, Anodon, &c., for Dissection purposes.

THOMAS BOLTON,

25 BALSALL HEATH ROAD, BIRMINGHAM.

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM.

THE LABORATORY, PLYMOUTH.

The following animals can always be supplied, either living or preserved by the best methods:—

Sycon; Clava, Obelia, Sertularia; Actinia, Tealia, Caryophyllia, Alcyonium; Hormiphora (preserved); Leptoplana; Lineus, Amphiporus; Nereis, Aphrodite, Arenicola, Lanice, Terebella; Lepas, Balanus, Gammarus, Ligia, Mysis, Nebalia, Carcinus; Patella, Buccinum, Eledone, Pectens, Bugula, Crisia, Pedicellina, Holothuria, Asterias, Echinus; Ascidia, Salpa (preserved), Scyllium, Raja, &c., &c.

For prices and more detailed lists apply to
Biological Laboratory, Plymouth.

THE DIRECTOR.

ALBERT EDWARD JAMRACH

(Late CHARLES JAMRACH),

NATURALIST,

180 ST. GEORGE STREET EAST.

Implements of Savage Warfare, Idols, Sacred Masks, Peruvian Pottery, Netsukis China, Lacquers, Gong, Shells, and other Curios.

HOLLOWAY'S OINTMENT CURES

Gout, Rheumatism, Lumbago, Sciatica, Cuts, Bruises, Sprains, &c.

INVALUABLE FOR ALL SKIN DISEASES.

Holloway's Ointment and Pills may be obtained of
all Medicine Vendors.

NOTICE.—Advertisements and business letters for NATURE should be addressed to the Publishers; Editorial communications to the Editor. The telegraphic address of NATURE is "PHUSIS," LONDON.

SUBSCRIPTIONS TO "NATURE."

	£	s.	d.
Yearly	1	8	0
Half-yearly	0	14	6
Quarterly	0	7	6
TO ALL PLACES ABROAD:—			
Yearly	1	10	6
Half-yearly	0	15	5
Quarterly	0	8	0

Cheques and Money Orders payable to MACMILLAN & CO., Limited.
OFFICE: ST. MARTIN'S STREET, LONDON, W.C.

CO-OPERATIVE WORLD TRAVEL

Organised by 'HENRY S. LUNN, M.D., F.R.G.S.'
W. HOLDSWORTH LUNN & CONNOP F.S. PEROWNE.

A Cruise to the CENTRAL MEDITERRANEAN.

(MARSEILLES, PALMA, ALGIERS, MALTA, SICILY, SALERNO
AND CAPRI, NAPLES, MARSEILLES.)

(Return Ticket to MARSEILLES included.)

AN EIGHTEEN DAYS' CRUISE FOR £21 OS. AND UPWARDS.

s.v. ARGONAUT. Tonnage, 3254; h.-p., 4000.

£10 10s. and £13 13s. TOURS TO ROME.

Extensions to NAPLES, FLORENCE, VENICE,
and the ITALIAN LAKES.

Full particulars from the Secretary, 5 Endsleigh Gardens,
Euston, London, N.W.

ORIENT COMPANY'S PLEASURE CRUISES

By their Steamship

LUSITANIA (3912 tons register),

For MOROCCO, BALEARIC ISLES, GREECE, TURKEY,
ALGERIA, &c., embarking passengers at London, 6th April, and at
Villefranche (Nice), 16th April.

The following places will be visited:—TANGIER, PALMA, VILLE-
FRANCHE, PIRÆUS (for Athens), CONSTANTINOPLE, MALTA,
ALGIERS, GIBRALTAR. The Steamer will arrive back in London
on 12th May.

String Band, Electric Light, High-class Cuisine.

Managers { F. GREEN and CO. } Head Offices,
{ ANDERSON, ANDERSON, and Co. } Fenchurch Avenue.

For passage, apply to the latter Firm, at 5 Fenchurch Avenue, London,
E.C.; or to the West End Branch Office, 16 Cockspur Street, S.W.

THE MOST NUTRITIOUS.

E P P S'S

GRATEFUL—COMFORTING.

C O C O A

BREAKFAST—SUPPER.

Sale by Auction.

PRELIMINARY NOTICE.

TUESDAY AND WEDNESDAY, MARCH 27 and 28.
THE "SAMUEL STEVENS" COLLECTION.

MR. J. C. STEVENS begs to announce that

he has received instructions from the Executors to Sell by Auction, at
his Great Rooms, 38 King Street, Covent Garden, on Tuesday and
Wednesday, March 27 and 28, the well-known Collection of British
Lepidoptera, formed by the late SAMUEL STEVENS, Esq., the result of
over sixty years collecting and breeding; consisting probably of over
100,000 specimens, and amongst them some wonderful and exceptional
varieties of a very large number of species, and a long series of many
rare and extinct species too numerous to mention.

On view day prior, to till 4. Catalogue in preparation, and can be had on
application.

CHARGES FOR ADVERTISEMENTS.

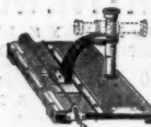
	£	s.	d.
*Three Lines in Column	0	2	6
Per Line after	0	0	9
One Eighth Page, or Quarter Column	0	18	6
Quarter Page, or Half a Column	1	15	0
Half a Page, or a Column	3	5	0
Whole Page	6	6	0

* The first line being in heavy type is charged for as Two Lines.

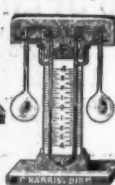


HARRIS'S ORIGINAL PATTERN ATWOOD MACHINE, Accurate and Reliable, 8 to 9 feet high, Graduated, £3 15s.

HARRIS'S SPECIALITIES.—CATALOGUES UPON APPLICATION.



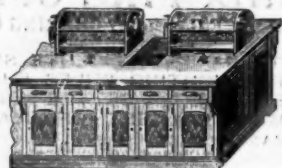
Vernier Microscope, 796A, £2 2s. 6d.



Registered Differential Thermometer, 6287A, 15s. 6d.



New Cathetometer, 787C, £5 1s. 6d.



Drawing Model.

Complete Laboratory Furnishing.

ESTIMATES FREE.

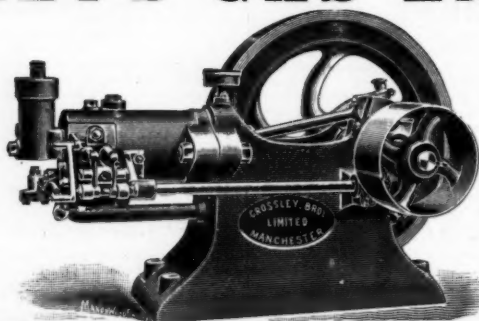
Telegraphic Address :
"Science," Birmingham.
Telephone No. 10.

PHILIP HARRIS & Co., Ltd.,

COMPLETE LABORATORY FURNISHERS, BIRMINGHAM.

CROSSLEY'S GAS ENGINES.

RECENTLY
REMODELLED.



GREAT
REDUCTION
IN
GAS
CONSUMED.

CROSSLEY BROS., LTD., OPENSHAW, MANCHESTER. WATSON'S NEW MICROSCOPES AND APPARATUS.



WATSON'S HOLOSCOPIC EYEPIECES, for use with either APOCHROMATIC or ACHROMATIC OBJECTIVES, an adjustment being provided to the special lenses employed, for altering the correction. There is no sacrifice of efficiency, the performance being equal to the most expensive Compensating or Huyghenian Oculars.

Magnifying Powers—

6 in. tube length, 5, 7, 10, and 14 diameters.
10 in. " 7, 10, 14, and 20 "

PRICE, in Student's Size and Pattern, either power, 17/6 each.

For Full Particulars see Supplemental List, Post Free.

WATSON'S PARACHROMATIC OIL IMMERSION CONDENSER.

Total aperture, 1.30; applanatic aperture exceeds 1.25. Undoubtedly the finest Condenser obtainable for high-power work. Optical part only ... £5 0 0

Completely mounted with Iris Diaphragm and Set of Stops ... £8 10 0

WATSON'S "SCHOOL" MICROSCOPE, New Model, complete with 1 in. Objective, in Case ... £3 3 0

WATSON'S "ROYAL" MICROSCOPE. A new model high-class instrument.

WATSON'S "FRAM" MICROSCOPE. A highest-class instrument at a very moderate cost.

BACTERIOLOGICAL APPARATUS. MICROTOMES. Apparatus for FIELD BOTANY and FIELD GEOLOGY. METAMORPHOSES and DISSECTED PREPARATIONS. BOTANICAL and PHYSIOLOGICAL MODELS.

For Particulars of all the above, see Watson's New Supplemental List to Catalogue No. 2, Post Free on application.

Watson's Catalogue (No. 3) is a Classified List representing a Stock of 40,000 first-class Micro-Slides, Post free on application.

W. WATSON & SONS (Established 1837), Opticians to H.M. Government.

313, HIGH HOLBORN, LONDON, W.C. New Branch Now Open: 16 FORREST ROAD, EDINBURGH. And at 78 Swanston Street, Melbourne, Australia. Awarded 39 Gold and other Medals at the principal International Exhibitions of the World.

THE NEW STIGMATIC LENS.

SERIES II. F/6.

BRITISH DESIGN AND WORKMANSHIP.

Is the best All-round Lens for either Professional or Amateur use.

Each lens will give perfect definition with full aperture to the extreme corners of the plate it is sold to cover; with smaller stops it will cover at least two sizes larger, giving perfect sharpness all over the plate, and thus becoming a wide-angle lens of the highest excellence. Either combination may be used separately, giving foci of about 1½ and 2 times the length of that of the lens when used intact. The advantage of thus being able to choose the best point of view, irrespective of distance, will be at once apparent to the artistic worker.

EQUIVALENT TO FOUR LENSES AT THE PRICE OF ONE.

Eleven Sizes are now ready from 3¼ to 18 inches eq. focus.

CATALOGUE OF HIGH-CLASS CAMERAS AND LENSES, POST FREE.

J. H. DALLMEYER, Ltd., 25 NEWMAN STREET, OXFORD STREET, LONDON, W.

Printed by RICHARD CLAY AND SONS, LIMITED, at 7 & 8 Bread Street Hill, Queen Victoria Street, in the City of London and published by MACMILLAN AND CO., LIMITED, at St. Martin's Street, London, W.C., and THE MACMILLAN COMPANY, 66 Fifth Avenue, New York.—THURSDAY, Feb. 22, 1900.



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

No. 1583, VOL. 61]

THURSDAY, MARCH 1, 1900.

[PRICE SIXPENCE

Registered as a Newspaper at the General Post Office.]

[All Rights are Reserved.]

NEWTON & CO.'S

PATENT

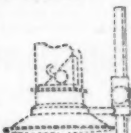
"DEMONSTRATOR'S" LANTERN,

FOR LIMELIGHT OR ELECTRIC.

With Prism for Erecting,
and for Vertical Projection.

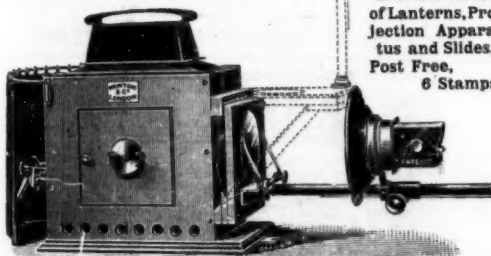
PRICE £10 10s.

3 FLEET ST.,
LONDON.



The most simple
and efficient
Single Lantern
yet constructed
for general
scientific work.

NEW CATALOGUE
of Lanterns, Pro-
jection Appara-
tus and Slides,
Post Free,
6 Stamps.



A NEW DEPARTURE in CHEMICAL BALANCES.



BALANCE on Polished
Mahogany Base, Three
Levelling Screws, &c.,
Plummet for levelling.
Adjusting Screws for
counterpoising Beam.
Steel Knife Edges.
Will carry 100 grms. in
each pan and turn with
1-2 m.g. 24/-.

BALANCE as above, with Agate Edges bound in Brass. Will carry 100
gms. and turn with 0.5 m.g. 29/6.

JOHN J. GRIFFIN & SONS, LD.,
20-26 SARDINIA STREET, LONDON, W.C.

**EARLY CHAPTERS IN
SCIENCE.**

A FIRST BOOK OF KNOWLEDGE OF NATURAL
HISTORY, BOTANY, PHYSIOLOGY,
PHYSICS AND CHEMISTRY FOR YOUNG PEOPLE.

By **Mrs. W. AWDRY**

(WIFE OF THE BISHOP OF SOUTH TOKYO, JAPAN).

EDITED BY **W. F. BARRETT, F.R.S.,**

PROFESSOR OF EXPERIMENTAL PHYSICS IN THE ROYAL
COLLEGE OF SCIENCE FOR IRELAND.

With nearly Two Hundred Illustrations. Crown 8vo, 6s.

"Deserves a warm welcome from all teachers of the young. . . . The
illustrations are models of clear, careful, and unconventional work."—
Literature.

"It can be confidently recommended to the young as a sound and plea-
santly written introduction to science."—*Guardian.*

JOHN MURRAY, ALBEMARLE STREET, W.

**NEGRETTI & ZAMBRA'S
LONG RANGE BINOCULARS AND TELESCOPES
FOR MILITARY PURPOSES.**

ILLUSTRATED PRICE LISTS FREE BY POST TO
ALL PARTS OF THE WORLD.

**SPECIAL TERMS TO YEOMANRY TROOPS AND VOLUNTEER
CORPS REQUIRING SEVERAL GLASSES.**



THE
**"READY-FOCUS"
BINOCULAR.**

A great
improvement over the ordinary system
of Focussing.

Invaluable in watching moving
objects.

NEGRETTI & ZAMBRA,
SCIENTIFIC INSTRUMENT MAKERS TO THE QUEEN,
38 HOLBORN VIADUCT, E.C.
BRANCHES: 45 CORNHILL; 122 REGENT STREET.

UNIVERSITY OF EDINBURGH.

CHAIR OF MEDICINE.

The Curators of Patronage of the University of Edinburgh will, on a date to be afterwards fixed, proceed to the Election of a PROFESSOR OF MEDICINE, in room of the late Professor SIR THOMAS GRAINGER STEWART.

Each Candidate for the Chair is requested to lodge with the undersigned, not later than Saturday, 14th April next, eight copies of his application and eight copies of any testimonials which he may desire to submit. One copy of the application should be signed.

R. HERBERT JOHNSTON, W.S., Secretary.

66 Frederick Street, Edinburgh, 22nd February, 1900.

UNIVERSITY OF SOUTH WALES
AND MONMOUTHSHIRE.

(A CONSTITUENT COLLEGE OF THE UNIVERSITY OF WALES.)

The Council invites applications for the Post of DEMONSTRATOR and ASSISTANT LECTURER in ANATOMY. Salary, £120.

Applications and testimonials, which need not be printed, should be sent on or before March 10th, 1900, to the undersigned, from whom further particulars may be obtained.

J. AUSTIN JENKINS, B.A.,
Secretary and Registrar.

Cardiff, 13th February, 1900.

CIVIL SERVICE COMMISSION.

FORTHCOMING EXAMINATION.

DRAUGHTSMAN in the Hydrographic Department of the Admiralty (17-25), 13th March. Expertness in Hydrographical Chart Drawing essential.

The date specified is the latest at which applications can be received. They must be made on forms to be obtained, with particulars, from the SECRETARY, Civil Service Commission, London, S.W.

CHEMIST, Ph.D., late 1851 Exhibition

Science Scholar, &c., experienced in Inorganic and Organic Chemical Research and Analysis, desires Appointment in Chemical Works or otherwise in England, Colonies or America, where experience would be useful.—Apply, "G. H.," NATURE Office.

ROYAL INSTITUTION OF GREAT
BRITAIN,

ALBEMARLE STREET, PICCADILLY, W.

The Right Hon. LORD RAYLEIGH, M.A., D.C.L., LL.D., Sc.D., F.R.S., M.R.I., Professor of Natural Philosophy, R.I., will, on Saturday next, March 3, at Three o'clock, begin a Course of Six Lectures on "Polarised Light."

Subscription to this Course, One Guinea.

LONDON MATRICULATION AND HOSPITAL
SCHOLARSHIPS.

QUERNMORE.

Special Preparation for the above. Privately, in Class, or by Correspondence, by Messrs. JOHN GIBSON (First Class, Cambridge) and G. LÖLY (First Class, London), with large Staff of Specialist Tutors. Resident Pupils received at Upper Norwood. Long list of successes on application.

N.B.—The London Matriculation Guide, with Examination Papers and Solutions (price 1s.), is issued each January and June.

Address: Messrs. GIBSON & LÖLY, 24 Chancery Lane, W.C.

INSTRUCTION IN
PURE CULTIVATION OF YEAST,

According to HANSEN'S Methods.

Courses for Beginners, as well as for Advanced Students, in Physiology and Technology of Fermentations—Biological Analysis of Yeast.

Manuals:—E. Chr. Hansen: "Practical Studies in Fermentation." London (Spon), 1896. Alfred Jørgensen: "Micro-organisms and Fermentation." London (F. W. Lyon), 1893.

Further Particulars on Application to the Director, ALFRED JØRGENSEN, The Laboratory, Copenhagen, V.

SCIENCE EXAMINATIONS.

For LONDON and other UNIVERSITIES, the
CONJOINT BOARD, &c.

Well-equipped LABORATORIES, DAY AND EVENING. Personal or Class Tuition.

"R.," 9 Heathcote Street, Gray's Inn Road, W.C.

Now Ready, 8vo, Price 6s. net.

RECENT & COMING
ECLIPSES.

BY

SIR NORMAN LOCKYER, K.C.B., F.R.S.

Second Edition, containing an account of the observations made at Viziadrag, in India, in 1898, and of the conditions of the Eclipses visible in 1900, 1901 and 1905.

MACMILLAN AND CO., LTD., LONDON.

EVERETT & CO.,
MECHANICAL ENGINEERS AND
ELECTRICIANS,

22 CHARTERHOUSE SQUARE, E.C.

Makers of High-Grade Physical and Electrical Apparatus.

Apparatus designed and made for Laboratories and Research Work.

ALL KINDS OF EXPERIMENTAL WORK.

Our List is now ready, and may be had post free on application.

LETCHER & SONS (formerly Letcher Bros.),

SCIENTIFIC INSTRUMENT MAKERS,

25 TURNPIKE LANE, HORNSEY, N.

BLOWPIPE CABINETS. SPECIALITY: SOCIETY OF ARTS SETS.



THE...
SMITH PREMIER
Typewriter..

Leads all other...
Writing Machines
in point of modern
improvements...
simple construction,
and wearing
qualities.....

PURCHASERS of Smith Premier Typewriters may be absolutely certain they have the best writing machines that can be turned out by a wise combination of men, material, and money.

SEND FOR ART CATALOGUE, POST FREE.

The Smith Premier Typewriter Co.,

14 Gracechurch Street,
LONDON, E.C.

BARGAINS IN SCIENTIFIC BOOKS.

BEDDARD, M.A. (FRANK E.), ANIMAL COLORATION. An Account of the Principal Facts and Theories relating to the Colours and Markings of Animals. With 4 Coloured Plates and Woodcuts in the Text, Demy 8vo, Cloth (6s.). 2s. 9d.

McALPINE (Prof. D.), BIOLOGICAL ATLAS—A GUIDE TO THE PRACTICAL STUDY OF PLANTS AND ANIMALS, adapted to the Requirements of the London University, Science and Art Department, and for Use in Schools and Colleges, containing 24 Plates, with 423 Coloured Figures and Diagrams, with Text giving Arrangement and Explanation, Equivalent Terms, Glossary, and Classification, Royal 4to, Half Cloth (7s. 6d.). 1s. 9d.

COLE, F.R.M.S. (A. C.), THE METHODS OF MICROSCOPICAL RESEARCH, A PRACTICAL GUIDE TO MICROSCOPICAL MANIPULATION. Second Edition, much Enlarged, 8vo, Cloth (6s.). 1s. 6d.

SANDFORD (E.), A MANUAL OF EXOTIC FERNS AND SELAGINELLA. Comprising descriptions of over 1000 Species and Varieties, and upwards of 500 Synonyms, also Notes on their History, Culture and Management. Crown 8vo, Cloth (6s. 6d.). 1s. 3d.

BRITTEN, F.L.S. (JAMES), EUROPEAN FERNS, THEIR FORM, HABIT AND CULTURE, with 30 Facsimile Coloured Plates, Painted from Nature by D. BLAIR, F.L.S., Demy 4to, Cloth (21s.). 7s.

NEWMAN, F.Z.S. (EDWARD), BRITISH BUTTERFLIES AND MOTHS. Illustrated with nearly 900 Life-size Figures of Species of Butterflies and Moths. Super Royal 8vo, Cloth, Gilt Edges (25s.). 12s.

Postage 4d. extra on one, or 6d. on two.

H. J. GLAISHER, New and Remainder Bookseller, 57 Wigmore Street, London, W.

Catalogues Post Free on application.

THE SCIENTIFIC ROLL AND MAGAZINE OF SYSTEMATIZED NOTES.

THIS WORK IS A VALUABLE GUIDE, BIBLIOGRAPHY, AND INDEX TO SCIENCE.

In preparation.

BACTERIA (Botanical Section).

Although these are the simplest of plants, there is probably no group of organisms which exceeds them in interest or importance. Their operations affect the welfare of every member of the community, as also of the whole organic world. A full knowledge of them is essential in all questions bearing upon public and private health, agriculture, the microbial diseases of animals and of plants; and it is important in many industries, such as those dealing with milk, butter, hay, flax, tobacco, and others.

The group will be dealt with in three octavo volumes of about 500 pp. each. The subscription price will be 10s. for each volume, payable on delivery of the first number of the volume; or arrangements may be made to supply only the portions relating to a particular species, genus, or topic, at a proportionately reduced rate. The first volume will be commenced next summer, and if sufficient subscribers support the work, the three volumes will be completed in three years. As all the matter will be systematized, the series will be equivalent to a good bacteriological library, with the advantage that the information on any particular point will be comprised within a comparatively few pages, and not scattered over thousands of pages in a host of journals and books.

The names and addresses of subscribers, and applications for prospectus may be sent to the undersigned.

The undersigned will be glad to hear from PRINTERS willing to give estimates for printing, and from PUBLISHERS willing to consider terms for publishing the above-mentioned work.

A. RAMSAY,
4 Cowper Road, Acton, London, W.

THE SCIENTIFIC ROLL AND MAGAZINE OF SYSTEMATIZED NOTES. METEOROLOGICAL SECTION.

CLIMATE: GENERAL. 4s.
CLIMATE: AQUEOUS VAPOUR. 6s. [Reprinting.
CLIMATE: BARIC CONDITION. Present Subscription Price, 10s.
The last No. is in Press.

To be followed by
CARBONIC ACID, CHEMICAL RAYS, &c., to WIND.
O DRISCOLL, LENNIX & CO., 10 and 12 Elephant Road, Elephant and Castle, London, S.E.

JUST OUT.

Demy 8vo, Uncut, Price 31s. 6d. net, by post 32s.

BRITISH DRAGONFLIES:

Being an Exhaustive Treatise on our Native Odonata; their Collection, Classification and Preservation.

By W. J. LUCAS, B.A., F.E.S.

Very fully illustrated with 27 Plates illustrating 39 Species, exquisitely printed in Colour, and numerous Black and White Engravings.

CRIES AND CALL NOTES OF WILD

BIRDS. A Popular description of the notes employed by our commoner British birds in their songs and calls. Illustrated by musical notation. By C. A. WITCHELL. 12s., by post 12. 2d.

NATURALIST'S DIRECTORY for 1900.

Sixth year of issue. Invaluable to all Students and Collectors. 12. 6d., by post 12. 9d.

PRACTICAL TAXIDERMY. A Manual

of Instruction to the Amateur in Collecting, Preserving and Setting up Natural History Specimens of all kinds. By M. BROWNE, F.Z.S. 2nd Edition. 7s. 6d., by post 7s. 10d.

BOOK OF BRITISH HAWK MOTHS.

A Popular and Practical Manual for all Lepidopterists. Copiously illustrated from the Author's own exquisite drawings. By W. J. LUCAS, B.A. 3s. 6d., by post 3s. 9d.

VIVARIUM. Snakes, Lizards, and other

Reptiles, and How to Keep them in Confinement. By Rev. G. C. BATEMAN. Illustrated. 7s. 6d. net, by post 8s.

Full Catalogue on Application.

London: L. UPCOTT GILL, 170 Strand, W.C.

VERLAG VON GUSTAV FISCHER IN JENA.

Soeben erschien:

JENAER GLAS

und seine Verwendung
IN WISSENSCHAFT UND TECHNIK.

Von DR. H. HOVESTADT.

Mit 29 Abbildungen im Text.

Preis: Broch. 9 Mark, Geb. 10 Mark.

JUST PUBLISHED BY THE ALEMbic CLUB.

LECTURES ON THE HISTORY

OF THE

DEVELOPMENT OF CHEMISTRY

SINCE THE TIME OF LAVOISIER

By Professor A. LADENBURG.

Translated from the Second German Edition

By LEONARD DOBBIN, Ph.D.

(With additions and corrections by the author).

Cloth, Crown 8vo, 373 pages. Price 6s. 6d. net; by Post, 6s. 10d.

Edinburgh: WILLIAM F. CLAY, 18 Teviot Place.

Just Published. One Volume, Folio, Cloth, £1 5s. net.

PUBLICATIONS OF SIR WILLIAM

HUGGINS'S OBSERVATORY. Vol. I.: An Atlas of Representative Stellar Spectra, from A4870 to A3300, together with a Discussion of the Evolutional Order of the Stars, and the Interpretation of their Spectra. Preceded by a Short History of the Observatory. With 13 Plates and Engravings.

WILLIAM WESLEY & SON, 28 Essex St., Strand, London.

CO-OPERATIVE WORLD TRAVEL

Organised by HENRY S. LUNN, M.D., F.R.G.S.,
W. HOLDSWORTH LUNN & CONNOP F.S. PEROWNE.

A Cruise to the CENTRAL MEDITERRANEAN.

MARSEILLES, PALMA, ALGIERS, MALTA, SICILY, SALERNO
AND CAPRI, NAPLES, MARSEILLES.)

(Return Ticket to MARSEILLES included.)

AN EIGHTEEN DAYS' CRUISE FOR £21 0s. and UPWARDS.

S.Y. ARGONAUT. Tonnage, 3254; h.-p., 4000.

£10 10s. and £13 13s. TOURS TO ROME.

Extensions to NAPLES, FLORENCE, VENICE,
and the ITALIAN LAKES.

Full particulars from the Secretary, 5 Endsleigh Gardens,
Euston, London, N.W.

LIVING SPECIMENS FOR THE MICROSCOPE.

Volvox, Spirogyra, Desmids, Diatoms, Amœba, Arcella, Actinospherium,
Vorticella, Stentor, Hydra, Filicularia, Stephanoceros, Melicerta, and many
other Specimens of Pond Life. Price 1s. per Tube, Post Free. Helio-
pomatia, Astacus, Amphioxus, Rana, Anodon, &c., for Dissection purposes.

THOMAS BOLTON,

25 BALSALL HEATH ROAD, BIRMINGHAM.

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM.

THE LABORATORY, PLYMOUTH.

The following animals can always be supplied, either living
or preserved by the best methods:—

Sycon; Clava, Obelia, Sertularia; Actinia, Tealia, Caryophyllia, Alcy-
onium; Hormiphora (preserved); Leptoplana; Lineus, Amphiporus; Nereis,
Aphrodite, Arenicola, Lanice, Terebella; Lepas, Balanus, Gammarus,
Ligia Mysid, Nebalia, Carcinus; Patella, Buccinum, Eledone, Pectens
Bugula, Crisia, Pedicellina, Holothuria, Asterias, Echinus; Ascidia, Salpa
(preserved), Scyllium, Raia, &c., &c.

For prices and more detailed lists apply to
Biological Laboratory, Plymouth.

THE DIRECTOR.

ALBERT EDWARD JAMRACH

(Late CHARLES JAMRACH),
NATURALIST,

180 ST. GEORGE STREET EAST.

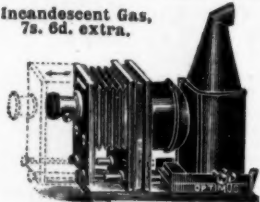
Implements of Savage Warfare, Idols, Sacred Masks, Peruvian Pottery,
Netsukis China, Lacquers, Gongs, Shells, and other Curios.

BORD'S PIANOS

BECHSTEIN PIANOS

"OPTIMUS" CANTILEVER PHOTOGRAPHIC ENLARGER.

Incandescent Gas,
7s. 6d. extra.



This already popular model
is finished in a very superior
and practical style. The lamp
gives a brilliant and even light.
The optical system is through-
out the best. The Lens will
be found to give a very flat
field and good marginal defini-
tion.

* SUITED FOR POCKET
CAMERA NEGATIVES.

Diam. of Condenser	... 4in.	5in.	6in.	8in.	10in.
Price, no Front Lens	... 62/-	70/-	80/-	110/-	200/-
Extra for Front Lens	... 27/-	27/-	37/-	63/-	63/-
Covering Plates	... 3 1/2 x 3 1/2	4 1/2 x 3 1/2	6 1/2 x 4 1/2	8 1/2 x 5 1/2	10 1/2 x 6 1/2

Catalogue POST FREE.

PERKEN, SON & CO.,

WATKINS & DONCASTER,

NATURALISTS,
AND MANUFACTURERS OF

CABINETS AND APPARATUS

FOR ENTOMOLOGY, BIRDS' EGGS, AND ALL BRANCHES OF
NATURAL HISTORY.

SPECIAL SHOW-ROOM FOR CABINETS.

Call or send for detailed Catalogue (88 pp.), Post free on
application.

N.B.—For Excellence and Superiority of Cabinets and
Apparatus, references are permitted to distinguished
patrons, Museums, Colleges, &c.

A LARGE STOCK OF INSECTS AND BIRDS' EGGS.

Birds, Mammals, &c., Preserved and Mounted by First-class Workmen
with true natural surroundings. All Books and Publications on Natural
History supplied.

36 STRAND, LONDON, W.C.

(Five Doors from Charing Cross.)

MINERALS, ROCKS & FOSSILS.

COLLECTIONS FOR STUDENTS.

Carefully labelled and arranged in Boxes with Card Trays.

50 Minerals, 12/6; 100 do., 21/-; 200 do., 42/-.

Rocks and Fossils at similar prices.

300 Minerals in Cabinet, £4 4s.; 400 do., £5 12s. 6d.

Catalogues Post Free.

THOMAS D. RUSSELL,

78 NEWGATE STREET, LONDON, E.C.

PHYSIOGRAPHY and GEOLOGY.

COLLECTIONS & MICROSCOPIC SLIDES,

As advised by Science and Art Directory, arranged by

JAMES R. GREGORY & CO.,

Mineralogists, &c.,

To Science and Art Department, British, Indian and Colonial
Museums, &c.

NOVELTIES and RARE GEMS and PRECIOUS STONES.

Mineral Specimens for Museums, and Collectors, and all purposes.
Rock Specimens and Microscopic Sections of Rocks and Minerals

NEW AND VALUABLE MINERAL SPECIMENS CONSTANTLY
ARRIVING.

Works & Offices: 1 Kelso Place, KENSINGTON, W.

NEW CATALOGUES AND LISTS FREE.

25 per cent. Discount for Cash, or 14/6 per month (second-hand, 10/6 per
month) on the Three Years' System. Lists free of

C. STILES & CO., 40 & 42 Southampton Row, London, W.C.

PIANOS EXCHANGED.

These magnificent Pianos for Hire on the Three Years' System at
advantageous prices and terms. Lists and particulars free of

CHAS. STILES & CO., 40 & 42 Southampton Row,
LONDON, W.C.

"OPTIMUS" MAGIC LANTERNS FOR DRAWING ROOM AND LECTURE HALL.

Each Lantern is efficient for Exhibitions.
The Lens gives crisp definition, being a
superior Achromatic Photographic Combination,
with Rack and Pinion, compound Con-
denser of 4-in. diameter. Each has 3-wick
Refillable Lamp, and is Complete in box.
(4-wick Lamp, 2s. extra.)



Mahogany outside Body, Panelled Door,
Brass Stages, and 3-draw Sliding Tubes, so
that lenses of long focus may be used when
projecting upon a screen at a great distance, £5 5s.

Mahogany outside Body, lined with metal, making a
thoroughly practical instrument, and really good value ... £2 12 0

Russian Iron Body, Brass Sliding Tubes (Educational)... 3 3 0

Do. do. (College) ... 2 8 0

99 HATTON GARDEN,
HOLBORN CIRCUS, E.C. LONDON.

ONLY FOUR DAYS MORE.

On Tuesday next, March 6th, perhaps on Monday, it will be imperative that the *Standard* shall finally withdraw the offer of THE LIBRARY OF FAMOUS LITERATURE at the introductory price.

ORDERS MAY BE BOOKED BY TELEGRAPH

Up to Tuesday, 5 p.m., but the *Standard* cannot guarantee to execute all such orders, and reserves the right to return those that arrive at the last moment. To be certain, therefore, of securing one of the few remaining copies of this great work, which makes AN IDEAL LIBRARY FOR THE HOME (containing 1000 of the world's masterpieces), it is necessary to send your order NOW.

A GREAT OPPORTUNITY THAT IS PASSING.

A man is never more vexed than when he has just missed a train and sees it moving out of the station, taking other people to the place where he wanted to go. He did not know until that moment how keen he was to go, and in all probability he lost the train because he had not made up his mind until the last moment.

That is the frame of mind in which a good many people will find themselves when the *Standard* has withdrawn the temporary offer it now makes in connection with the LIBRARY OF FAMOUS LITERATURE. The advertisements have appeared day after day. If you like to have the best set of books in your house, and like to get the best possible bargain for your money, you must have said to yourself that you would like to secure a copy of THE LIBRARY. But you had other things to think about. The paper was full of war news, and you did not stop to cut out the order form just then.

NOW, THERE IS NO MORE TIME TO LOSE. If you delay, the train will have started without you—the train, so to speak, that runs through the varied and beautiful domains of the world's literature, where the masterpieces of all the ages stand forth like mountains, where fiction and humour and verse flow in ample streams, where harvests of pleasure and profit, too, await your coming. It is a land of delights, to which, if you have but little leisure, you may go for only ten minutes at a time, always returning refreshed and stimulated; a land in which you may spend long, cosy evenings, forgetting the March winds; a land to which the members of your family may journey with you and return with a thousand pleasant impressions and recollections to discuss.

To follow out the simile, to-day, you may for half-fare book your passage to this lovely country, which is so easily reached and yet so far removed from the cares and fatigues of daily life, and your ticket will be not for one journey only, but for life, enabling you to run all the way up and down the line as often as you please, stopping where you wish.

Few will wish to lose such an opportunity! But, to drop metaphor, probably on Saturday, certainly by Monday, the Introductory Edition will be exhausted, and no more sets will remain to be had at half the regular price. If you do not wish to lose a great opportunity, you must make up your mind at once.

SPECIAL INTRODUCTORY TERMS TO BE WITHDRAWN MARCH 6, OR SOONER.

Those who subscribe now may obtain the Complete Work, Twenty Volumes, AT A REDUCTION OF FIFTY PER CENT. from the

THE LIBRARY OF FAMOUS LITERATURE



SHOWING THE HANDSOME THREE QUARTER LEVANT MOROCCO BINDING IN THE SPECIAL BOOKCASE.

regular prices hereafter to prevail. THE LIBRARY is not sold in parts or by single volumes, but only in complete sets. The entire Twenty Volumes will be sent, all at one time, upon a preliminary payment of but HALF-A-GUINEA; further payments, after the Twenty Volumes are in your home, to be at the rate of 9, 12, 15, or 21 shillings per month, as indicated in the Order Forms. Intending subscribers may examine the work, in the different styles of binding, at the *Standard* Office, 23, St. Bride-street, near Ludgate Circus; and at the establishment of Messrs. Chappell and Co., Pianoforte Manufacturers, 50, New Bond Street, where orders may be booked, both for Cash Payments and on Monthly Instalments. A tasteful and convenient bookcase, made to contain the 20 volumes of THE LIBRARY, is supplied to subscribers at a low rate.

PRICES FOR CASH PAYMENT.

Those who prefer to send cheque in full and secure a discount for cash payment may secure the work at the following prices:

Cloth Binding	6½ Guineas.
Half Persian Calf (excellent binding for the price) ...	8½ Guineas.
Three-quarter Red Levant Morocco (especially recommended)	10½ Guineas.
Full Morocco Extra (for Presentation purposes) ...	14½ Guineas.
Price of the Bookcase, 18s. 6d.	

All cheques should be made payable to W. M. Jackson.

* NOTE ON BINDINGS. — THE LIBRARY is bound in Cloth only in conformity to the usual custom. THE HALF PERSIAN CALF is a very attractive and durable binding. But we particularly recommend the THREE-QUARTER RED LEVANT MOROCCO as the handsomest and most artistic form of the work, and on account of its relative cheapness. It is an ornament to the library or drawing-room. For presentation purposes, or for those who desire the finest bindings obtainable, the sumptuous FULL MOROCCO will be found to meet every requirement.

ORDER FORM.

(These special prices apply ONLY to the Introductory Edition, and will be withdrawn on or before March 6th.)

W. M. JACKSON, THE *STANDARD*, 23 St. Bride Street, London, E.C. 1900.

I enclose herewith HALF-A-GUINEA, for which please send me the complete set of 20 Volumes of THE LIBRARY OF FAMOUS LITERATURE, at the special advance-of-publication price, bound in—

(Strike out three of these.)

Cloth.

Half Persian Calf

Three-quarter Red Levant.

Full Morocco.

I agree to complete my purchase of the work by

15 further payments of 9s. per month (for Cloth).

* 15 " " 12s. " " (for Half Persian Calf).*

* 15 further payments of 15s. per month (for Three-quarter Red Levant).*

15 " " 21s. " " (for Full Morocco).

My next payment shall be due upon the despatch of the 20 volumes; and my succeeding payments on the corresponding day of each month thereafter. Until such payments are complete, I engage that the volumes, not being my property, shall not be disposed of by sale or otherwise. I further agree that if owing to unforeseen circumstances, of which you shall be the judge, the volumes cannot be delivered, the return of the deposit of Half-a-Guinea to me shall cancel this agreement.

Please also send the Special Bookcase made to contain the 20 volumes of THE LIBRARY, for which I agree to make one } Strike out if Bookcase further Monthly Payment of 18s. 6d., after the payments for the Books are completed. is not desired.

Signed.....

Address.....

Please address the package to.....

The Introductory Edition is sold at so low a price that the cost of carriage must be paid by the subscriber.

KODAK

cameras require no dark room for changing the films. The spools of exposures may readily and safely be sent by post, for development and printing, from all parts of the world. Kodaks for all purposes from £1 1s. to £7 7s. Full catalogue free.

KODAK, Limited,

43 Clerkenwell Road, LONDON, E.C.; Retail Branches: 60 Cheap-side, E.C.; 115 Oxford Street, W.; 171-173 Regent Street, W.

C. E. MÜLLER & CO., SCIENTIFIC GLASS BLOWERS

AND

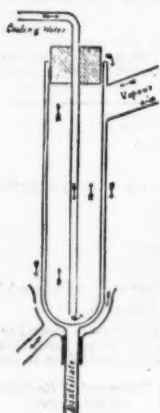
Manufacturers of Chemical
and Physical Apparatus.

PATENT DOUBLE SURFACE CONDENSER

Extremely Small and Light,
Great Efficiency.

PARTICULARS OF ABOVE AND PRICE
LISTS OF APPARATUS ON
APPLICATION TO

148 HIGH HOLBORN,
LONDON, W.C.



Medals and Highest Awards at all Great Exhibitions.

ROSS'

ESTD. 1830.



NEW SERIES SCIENCE LANTERNS

FOR SCHOOLS,
COLLEGES, & PRIVATE
EXHIBITIONS.

PHOTOGRAPHIC LENSES
AND CAMERAS.

MICROSCOPES,
TELESCOPES, FIELD
GLASSES, &c. &c.

ROSS' PATENT NEW MODEL

PRISMATIC

BINOCULAR GLASS.

"The power and field of a Telescope in the compass of an Opera Glass."



Combining Extreme Portability with High Power, Perfect Mechanical Construction, and Exquisite Definition.	Magnification.	Binocular.
	6 times	... £8 0 0
	8 "	... 8 0 0
	10 "	... 10 0 0
	12 "	... 10 0 0

ROSS, Ltd., Manufacturing Opticians,

111 NEW BOND STREET, LONDON, W.,
And 31 COCKSPUR STREET, CHARING CROSS, S.W.

IMPROVED D'ARSONVAL GALVANOMETERS.

PRICES

£10-0-0

AND

£4-10-0

LIBERAL DISCOUNTS.

Most
SENSITIVE
for
DEFLECTIVE,
ZERO,
OR
BALLISTIC
WORK.



Write for Price List and Particulars of Potentiometers,
Galvanometers, Electrical Thermometers, Experimental Direct and Alternating Current Sets, &c., to

CROMPTON & CO., LD.,

Laboratory { "THRIPLANDS," } LONDON, W.
KENSINGTON COURT,

**NEW MODEL
PORTABLE
EQUATORIAL
MOUNTING**
For 3" or 3½"
TELESCOPES.



Latitude Adjustment, Clamp for Declination Axis, Quick and Slow Motion, in Right Ascension.

EQUATORIAL MOUNTING with Divided Circles and Stand fitted with short Iron Column, Levelling Screws, and Metal Stretcher, £15 15s.; or, complete with 3" Telescope, £25.

ILLUSTRATED CATALOGUE GRATIS.

J. H. STEWARD,
OPTICIAN,

406 STRAND, 457 WEST STRAND,
7 GRACECHURCH STREET, LONDON.

**A NEW STEREOSCOPIC BINOCULAR
FIELD GLASS**
OF NEW FORM and CONSTRUCTION.

(English Patents, Nos. 5639 and 7942, 1894.)



Of handy size, with large field, brilliant definition, perfect achromatism, and very decided STEREOSCOPIC effect, and which, when once adjusted, are always ready for use.

Prices: £6 to £8.

For NAVAL MEN and DEERSTALKERS, &c. (we have made larger sizes for NIGHT and DAY USE, admitting more light, but of somewhat greater weight). Prices: Night, £10; Day, £11.

Illustrated Price List free.

CARL ZEISS (of JENA),

29 MARGARET STREET, REGENT STREET, LONDON, W.

SECOND-HAND ASTRO. TELESCOPES, &c.

4-inch by Troughton & Simms, Equatorial Mount with Clock.
4-inch by Cooke, Equatorial Mount.
3½-inch by Dallmeyer, Equatorial Mount.
Spectroscope with Diffraction Grating, £40.
Filar Micrometer by Browning, £15.
Large Transit Instrument by Troughton & Simms, 1½-inch Object Glass, 14-inch Circles divided on Silver.
Several other Telescopes, also Microscopes and other Instruments, by best Makers in Stock.

FULL LISTS ON APPLICATION.

C. BAKER, 244 HIGH HOLBORN, LONDON.



COSSOR,
67
FARRINGTON RD.,
E.C.

Original Maker of "X" RAY TUBES in England.

FOCUS TUBES giving finest possible definition. IMPROVED TUBE HOLDERS, with arrangement for securing wires to avoid perforation of tube. All kinds of "X" Ray Apparatus, Mercury Pumps, Screens, Spark Gaps, &c. Applications for Price Lists invited.

TO SCIENCE LECTURERS.
HUGHES' MOTO-PHOTOSCOPE FOR LIVING PICTURES.

THE MOST PERFECT.

NO SHUTTER, therefore no Flickering. Superb Mechanism. The Moto-Photo Camera for taking the Pictures. Illustrated Lists, ad. See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN, &c. Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great success. New Oxyhydrogen Microscope. Science Lanterns for Class Demonstration. Magnificent Results. Docwra Triple, Prize Medals Highest Award. Supplied to the Royal Polytechnic Institution, Dr. H. GRAY-TAN GUINNESS, Madame ADELINA PATTI, &c., &c. Patent Pamphlets, Science Lanterns. The Universal Lantern 4-inch Condensers, 4-wick Lamp, Portrait Combination front Lenses, 12s. 6d., Marvellous value. Science Lecture Sets. Novelties. The Lantern Kaleidoscope. Cheapest Lantern Outfits in the World. Grandly Illustrated Catalogue, over 180 choice Engravings, 6d.; Postage, 3d. List of 300 Lecture Sets, Science Subjects, Views, &c., 6d.; Postage, 3d. Pamphlets Free. W. C. HUGHES, SPECIALIST, Brewster House, 82 Mortimer Road, Kingsland, N.

For Photography, Unsurpassed for fine definition.

COOKE LENSES

TAYLOR, TAYLOR, & HOBSON,
Stoughton Street Works, Leicester;
and 18 Berners Street, London, W.

PHOENIX FIRE OFFICE,
19 LOMBARD ST., E.C., and 57 CHARING CROSS, S.W.
ESTABLISHED 1782.

MODERATE RATES. ABSOLUTE SECURITY.
ELECTRIC LIGHTING RULES SUPPLIED.

LIBERAL LOSS SETTLEMENTS.
PROMPT PAYMENT OF CLAIMS.

FRANCIS B. MACDONALD, SECRETARY.
LOSSES PAID OVER £22,000,000

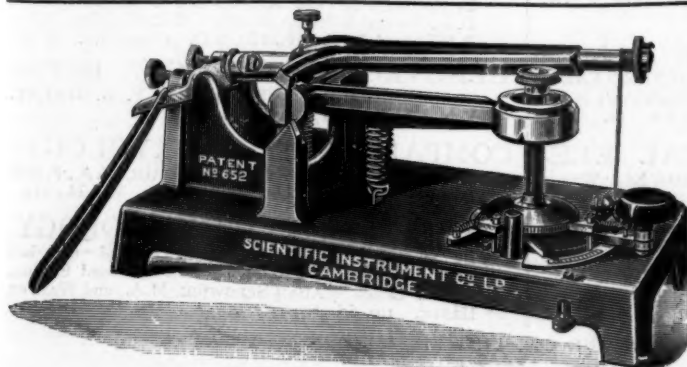
THE CAMBRIDGE
SCIENTIFIC INSTRUMENT CO.
Ltd., CAMBRIDGE.

NEW ROCKING MICROTOME.
1900 PATTERN. [PATENTED.]

This Instrument possesses the following great improvements over the old type of instruments:—
(1) Increased rigidity. (2) The impossibility of cutting thin and thick sections. (3) The impossibility of tearing sections on the upward movement of the object. (4) A graduated arc for showing the thickness of the sections. (5) Catch for holding the object above the edge of the stage. (6) Improved method of fixing the cord. (7) A new object holder.

PRICE (including object holder), £5 0 0
Write for Pamphlet descriptive of the above instrument.

Address all communications:—
INSTRUMENT COMPANY, CAMBRIDGE.



MACMILLAN & CO.'S BOOKS

FOR

STUDENTS OF ANATOMY, PHYSIOLOGY, AND EMBRYOLOGY.

SIXTH EDITION, LARGELY REVISED, OF PART IV.

A TEXT-BOOK OF PHYSIOLOGY. By Sir MICHAEL FOSTER, K.C.B., M.A., M.D., LL.D., F.R.S. Professor of Physiology in the University of Cambridge. Assisted by W. H. RIVERS, M.A., M.D., University Lecturer in Physiological and Experimental Psychology in the University of Cambridge. Illustrated. Part IV. The Senses. 8vo. 10s. 6d. [Ready on Tuesday.]

TEXT-BOOK OF PATHOLOGICAL ANATOMY AND PATHOGENESIS. By Prof. ERNST ZIEGLER, of Tübingen. Translated and Edited for English Students by DONALD MACALISTER, M.A., M.D., B.Sc., F.R.C.P., and H. W. CATTELL, M.D. With Illustrations. Part I.—General. Second Edition. 12s. 6d. Part II.—Special. Sections I.—VIII. Third Edition. 17s. net. Sections IX.—XV. 17s. net.

A TEXT-BOOK OF COMPARATIVE ANATOMY. By Dr. ARNOLD LANG, Professor of Zoology in the University of Zürich. With Preface to the English Translation by Dr. ERNST HAECKEL. Translated by HENRY M. BERNARD, M.A. Cantab., and MATILDA BERNARD. Vols. I. and II. (completing the Invertebrates). 8vo. 17s. net. each.

LESSONS in ELEMENTARY ANATOMY. By ST. GEORGE MIVART, F.R.S., Author of "The Genesis of Species." Fcap. 8vo. 6s. 6d.

ELEMENTS of the COMPARATIVE ANATOMY OF VERTEBRATES. Adapted from the German of Dr. ROBERT WEIDERSHEIM, Professor of Anatomy, and Director of the Institute of Human and Comparative Anatomy in the University of Freiburg, in Baden. By Prof. W. N. PARKER. Second Edition. 12s. 6d. net.

The STRUCTURE of MAN: An INDEX to his PAST HISTORY. By ROBERT WIEDERSHEIM. Translated by H. and M. BERNARD. The Translation, Edited and Annotated, and a Preface written by G. B. HOWES, F.R.S., Professor of Zoology, Royal College of Science, London. With 105 Figures in the Text. 8vo. 8s. net.

A COURSE of INSTRUCTION in ZOOTOMY. Vertebrata. By T. JEFFERY PARKER, F.R.S., Professor of Biology in the University of Otago, New Zealand. With Illustrations. Crown 8vo. 8s. 6d.

HUMAN EMBRYOLOGY. By Prof. G. S. MINOT. 8vo. 25s. net.

The LIVING ORGANISM. An Introduction to the Problems of Biology. By ALFRED EARL, M.A., late Scholar of Christ's College, Cambridge; of the Inner Temple, Barrister-at-Law. Crown 8vo. 6s.

An ATLAS of PRACTICAL ELEMENTARY BIOLOGY. By G. B. HOWES. With a Preface by the Right Hon. T. H. HUXLEY, F.R.S. [New Edition in preparation.]

ELEMENTARY BIOLOGY. By T. H. HUXLEY, F.R.S., and H. N. MARTIN, F.R.S. New Edition. Revised and extended by G. B. HOWES and D. H. SCOTT. 10s. 6d.

LESSONS IN ELEMENTARY BIOLOGY. By Prof. T. JEFFERY PARKER, B.Sc., F.R.S. Illustrated. Third Edition, revised. 10s. 6d.

TEXT-BOOK of PHYSIOLOGY. By Sir MICHAEL FOSTER, K.C.B., M.D. With Illustrations. Sixth Edition, largely revised. In Four Parts. Part I. Blood—The Tissues of Movement, the Vascular Mechanism. 10s. 6d. Part II. The Tissues of Chemical Action, with their Respective Mechanisms—Nutrition. 10s. 6d. Part III. The Central Nervous System. 10s. 6d. Part IV. The Senses. 10s. 6d. Appendix. By A. S. LEA. 7s. 6d.

PHYSIOLOGY. By Sir MICHAEL FOSTER, K.C.B., M.D., Professor of Physiology in the University of Cambridge. With Illustrations. Pott. 8vo. 1s. [Science Primers.]

PHYSIOLOGY for BEGINNERS. By Sir M. FOSTER, K.C.B., M.D., and LEWIS E. SHORE, M.A., M.D., Fellow of St. John's College, Cambridge, and Senior Demonstrator of Physiology in the University of Cambridge. Globe 8vo. 2s. 6d.

LESSONS IN ELEMENTARY PHYSIOLOGY. By THOS. H. HUXLEY, F.R.S. Illustrated. New Edition, revised. 4s. 6d. Questions, 1s. 6d.

GENERAL PHYSIOLOGY. An Outline of the Science of Life. By MAX VERWORN, M.D., Ph.D., A.O. Professor of Physiology in the Medical Faculty of the University of Jena. Translated from the Second German Edition, and Edited by FREDERIC S. LEE, Ph.D. With 285 Illustrations. Medium 8vo. 15s. net.

A TEXT-BOOK of the PHYSIOLOGICAL CHEMISTRY OF THE ANIMAL BODY, including an Account of the Chemical Changes occurring in Disease. By ARTHUR GAMGEE, M.D., F.R.S. In Two Vols. Vol. I., 18s. Vol. II., 18s.

A COURSE OF ELEMENTARY PRACTICAL PHYSIOLOGY AND HISTOLOGY. By Sir M. FOSTER, K.C.B., and J. N. LANGLEY, D.Sc. Seventh Edition, edited by J. N. LANGLEY, D.Sc., F.R.S., and L. E. SHORE, M.D. Crown 8vo. 7s. 6d.

ELECTRO-PHYSIOLOGY. By Prof. W. BIEDERMANN. Translated by F. A. WELBY. Vols. I. and II. 17s. net each.

COMPARATIVE EMBRYOLOGY: A TREATISE ON. By F. M. BALFOUR, M.A., F.R.S. Illustrated. In Two Vols. Vol. I., 18s. Vol. II., 21s.

The ELEMENTS of EMBRYOLOGY. By Sir M. FOSTER, K.C.B., M.D., and the late FRANCIS M. BALFOUR, F.R.S. Second Edition, revised. Edited by ADAM SEDGWICK, M.A., and WALTER HEAPE. 10s. 6d.

MACMILLAN AND CO., LIMITED, LONDON.

MACMILLAN & CO.'S NEW BOOKS.

AN ELEMENTARY COURSE OF PRACTICAL ZOOLOGY.

By the late **T. JEFFERY PARKER**, D.Sc., F.R.S., Professor of Biology in the University of Otago, Dunedin, New Zealand, and **W. NEWTON PARKER**, Ph.D., Professor of Zoology at the University College of South Wales and Monmouthshire, in the University of Wales. With 156 Illustrations. Crown 8vo. 10s. 6d.

A MANUAL OF ZOOLOGY.

By the late Prof. **T. J. PARKER**, D.Sc., F.R.S., and Prof. **W. A. HASWELL**, M.A., D.Sc., F.R.S.

With Three Hundred Illustrations. Crown 8vo, 10s. 6d.

FIELD.—"For those who require a manual to assist them in acquiring an accurate knowledge of zoology, we know of no book superior to that under notice. . . . The illustrations are admirable. . . . We know of no work better fitted to fulfil the purpose for which it is designed than the one under notice. It is an admirable introductory text-book to scientific zoology."

TEXT-BOOK OF PALÆONTOLOGY.

By **KARL A. VON ZITTEL**,

Professor of Geology and Palæontology in the University of Munich. Translated and Edited by **CHAS. R. EASTMAN**, Ph.D., Assistant in Palæontology in the Museum of Comparative Zoology at Harvard. With 1476 Woodcuts. Medium 8vo, 25s. net.

* * * This English Edition is revised and enlarged by the Author and Editor in collaboration with numerous Specialists.

FIELD.—"An admirable introduction to the history of those fossils or petrified organic remains of plants and animals which existed before the present geological period and the advent of man on the face of the globe. . . . Will be of the greatest possible assistance to all geological students. . . . Too much praise cannot be bestowed on the accuracy and beauty of the illustrations."

THE VOICE: Its Physiology and Cultivation. By **WILLIAM A. AIKEN**, M.D. Brux., L.R.C.P. Lond. Crown 8vo. 3s. 6d.

A HISTORY OF MODERN PHILOSOPHY: a Sketch of the History of Philosophy from the Close of the Renaissance to our own Day. By Dr. **HARALD HOFFDING**. Translated from the German by **B. E. MEYER**. In 2 Vols., 8vo, 15s. net each Volume.

THE PRINCIPLES OF MECHANICS PRESENTED IN A NEW FORM.

By **HEINRICH HERTZ**, late Professor of Physics in the University of Bonn. With an Introduction by **H. VON HELMHOLTZ**. Authorised English Translation by **D. E. JONES**, B.Sc., District Inspector under the Department of Science and Art, &c., and **J. T. WALLEY**, M.A. 8vo, 10s. net.

ENGINEER.—"A very remarkable book. . . . A book which it is impossible to pass over in silence, fraught as it is with infinite possibilities of the future. It represents the latest work of one of the finest intellects of the century."

INTRODUCTION TO PHYSICAL CHEMISTRY. By **JAMES WALKER**, D.Sc., Ph.D., Professor of Chemistry in University College, Dundee. 8vo, 10s. net.

LANCET.—"The book is written in such a lucid way as to render its perusal free from that irksomeness which is so often the student's experience when confronted with theoretical considerations. The book should serve as an admirable introduction to more advanced works."

ELEMENTARY CHEMISTRY FOR HIGH SCHOOLS AND ACADEMIES.

By **ALBERT L. AREY**, C.E., Rochester (N.Y.) High School. Crown 8vo. 4s. net.

MARCH NUMBER NOW READY.

THE SCHOOL WORLD.

A MONTHLY MAGAZINE OF EDUCATIONAL WORK AND PROGRESS. PRICE SIXPENCE.

CONTENTS.

The Teaching of English in Public Schools. A Collection of Opinions by Experienced Teachers. I. By **James Gow**, M.A., Litt.D. II. By **E. W. Howson**, M.A. III. By **C. J. Battersby**, M.A. IV. By **Miss Amy Lumby**.—**Syllabus and Time Tables.** By **P. A. Barnett**, M.A.—**Experimental Chemistry.** (Illustrated.) II. The Atmosphere and its Constitution. Nitrogen and Oxygen. Moisture and Carbon Dioxide. By **Prof. J. B. Coleman**, A.R.C.S., F.I.C.—**Pioneers in Education.** III. The Significance of John Locke's Work for Education. By **Prof. Foster Watson**, M.A.—Notes for Lantern Lectures. II. **The Beginnings of English Colonization, 1492-1640.** By **C. S. Fearenside**, M.A., and **A. Johnson Evans**, M.A.—Play-Hour Books.—**Object Lessons in Botany.** By **Miss C. von Wyss**.—**Higher Education in Scotland.**—Items of Interest. (Illustrated.) General, From Abroad, Welsh, Scottish, Current History.—The Religious and Political Life of Rome.—Mr. Fabian Ware on Educational Reform.—Reviews of Recent School Books. (Illustrated.)—London Matriculation, June, 1900. Monthly Test Papers, No. 3.—Junior Oxford Local Examination, July, 1900. Monthly Test Papers, No. 3.—Preliminary Oxford Local Examination, July, 1900. Monthly Test Papers, No. 3.

* * * Also Ready, Volume I., containing Nos. I.-XII., January to December 1899, Demy 4to, 480 pp. Index.

Price 7s. 6d. net. Cloth Cases for binding Vol. I. are also ready, price 1s. net.

NO. II. NOW READY.

THE INTERNATIONAL MONTHLY.

A MAGAZINE OF CONTEMPORARY THOUGHT. FEBRUARY, 1900. PRICE 1s.

CONTENTS.—Art as a Means of Expression. By **W. J. Stillman**.—Japan's Entry into the World's Politics. By **Garrett Droppers**.—The Opera in America and Europe. By **H. T. Finck**.—The Future of the Short Story. By **E. Charlton Black**.—Recent Work in the Science of Religion. By **C. H. Toy**.

MACMILLAN AND CO., LIMITED, ST. MARTIN'S STREET, LONDON, W.C.

THE MOST NUTRITIOUS.
E P P S'S
GRATEFUL—COMFORTING.
C O C O A
BREAKFAST—SUPPER.

HOLLOWAY'S OINTMENT
CURES

Gout, Rheumatism, Lumbago, Sciatica, Cuts,
Bruises, Sprains, &c.

INVALUABLE FOR ALL SKIN DISEASES.

Holloway's Ointment and Pills may be obtained of
all Medicine Vendors.

ESTABLISHED 1851.
BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

INVESTED FUNDS

£10,000,000.

The BIRKBECK ALMANACK, with full particulars, post free.

FRANCIS RAVENSCROFT, *Manager.*

THE IRISH NATURALIST.

A Monthly Magazine of Irish Zoology, Botany, and
Geology. Price 6d.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD
PRAEGER, B.A.

Annual Subscription, 5s. Post Free to any Address.

Dublin: EASON & SON, LTD., 40 Lower Sackville Street
(to which Address Subscriptions should be sent).

London: SIMPKIN, MARSHALL, HAMILTON, KENT, & CO., Ltd.

THE PHYSICAL REVIEW.

A JOURNAL OF EXPERIMENTAL AND THEORETICAL PHYSICS.

CONDUCTED BY EDWARD L. NICHOLS, ERNEST MERRITT, AND FREDERICK BEDELL.

No. 1, Vol. X., JANUARY, 1900. PRICE 3s. NET.

CONTENTS.

A DETERMINATION OF THE NATURE OF THE ELECTRIC AND MAGNETIC QUANTITIES, AND OF
THE DENSITY AND ELASTICITY OF THE ETHER. I. By R. A. FESSENDEN.—POLARIZATION AND
INTERNAL RESISTANCE OF THE COPPER VOLTAMETER. By B. E. MOORE.—A NEW METHOD OF
COMPARING TWO SELF-INDUCTANCES. By H. V. CARPENTER.—NEW BOOKS.

MACMILLAN & CO., LIMITED, LONDON.

SCIENTIFIC WORTHIES.

The following is a list of the Steel Portraits that have appeared in the above Series:—

MICHAEL FARADAY.
THOMAS HENRY HUXLEY.
CHARLES DARWIN.
JOHN TYNDALL.
SIR GEORGE GABRIEL STOKES.
SIR CHARLES LYELL.
SIR CHARLES WHEATSTONE.
SIR WYVILLE THOMSON.
ROBERT WILHELM BUNSEN.
LORD KELVIN.
BARON ADOLF ERIK NOR-
DENSKJÖLD.

HERMANN L. F. HELMHOLTZ.
SIR JOSEPH DALTON HOOKER.
WILLIAM HARVEY.
SIR GEORGE B. AIRY.
J. LOUIS R. AGASSIZ.
JEAN BAPTISTE ANDRÉ DUMAS.
SIR RICHARD OWEN.
JAMES CLERK MAXWELL.
JAMES PRESCOTT JOULE.
WILLIAM SPOTTISWOODE.
ARTHUR CAYLEY.
SIR C. W. SIEMENS.

JOHN COUCH ADAMS.
JAMES JOSEPH SYLVESTER.
DMITRI IVANOWITSH MEN-
DELEEF.
LOUIS PASTEUR.

SIR ARCHIBALD GEIKIE.
LORD LISTER.
STANISLAO CANNIZZARO.
PROF. VON KÖLLIKER.
PROF. SIMON NEWCOMB.

N.B.—The Portraits of Sir A. Geikie, Lord Lister, Prof. Cannizzaro, Prof. von Kölliker, and
Prof. S. Newcomb belong to a New Series and are Photogravures.

Proof impressions of these, printed on India paper, may be had from the Publishers, price 5s. each; or the Series
of 32 Portraits in a Handsome Portfolio for £8 5s., carriage paid. The Portfolio may be had separately, price 6s.

Cheques and Money Orders payable to MACMILLAN & CO., Limited.

OFFICE OF "NATURE," ST. MARTIN'S STREET, LONDON, W.C.

NOTICE.—Advertisements and business letters for NATURE should be addressed to the Publishers; Editorial
communications to the Editor. The telegraphic address of NATURE is "PHUSIS," LONDON.

SUBSCRIPTIONS TO "NATURE."

	£	s.	d.
Yearly	1	8	0
Half-yearly	0	14	6
Quarterly	0	7	6
TO ALL PLACES ABROAD:—			
Yearly	1	10	6
Half-yearly	0	15	6
Quarterly	0	8	0

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
*Three Lines in Column	0	2	6
Per Line after	0	0	9
One Eighth Page, or Quarter Column	0	18	6
Quarter Page, or Half a Column	1	15	0
Half a Page, or a Column	3	5	0
Whole Page	6	6	0

* The first line being in heavy type is charged for as Two Lines.

Cheques and Money Orders payable to MACMILLAN & CO., Limited.

OFFICE: ST. MARTIN'S STREET LONDON, W.C.

NOTICE.—SPECIAL RE-ISSUE BY NATURE
OF THE
INTERNATIONAL SCIENTIFIC SERIES
FOR A STRICTLY LIMITED PERIOD.

EIGHTY-SIX VOLUMES.

**A COMPLETE LIBRARY OF SCIENCE AT
A GREATLY REDUCED PRICE.**

PUBLISHERS' PRICE	...	...	...	...	£21 10 0
BY INSTALMENT (TO-DAY)	...	...	...	...	£14 14 0
FOR CASH	...	...	...	...	£13 10 0

The "International Scientific Series" has a world-wide reputation, and is to be found in every well-equipped Library throughout the English-speaking world. No more generous or acceptable present could be made to any Public Library or individual than this magnificent Encyclopædia of Scientific Research.

Most of the works are illustrated, and many with beautiful coloured plates. The Series has been contributed to by men of science of the highest eminence, such as Tyndall, Herbert Spencer, Walter Bagehot, Alexander Bain, Stanley Jevons, Huxley, Sir John Lubbock, G. J. Romanes, Balfour Stewart, Sir Norman Lockyer, Draper, Bonney, Sir Hubert Parry, Sir E. Maunde Thompson. This list only professes to convey a slight idea of the attention that has been given to the whole Series by the selection of only the best writers to deal with the various subjects considered.

This special offer is open only for a short time, and intending purchasers will do well therefore to send their orders without delay.

For the benefit of those who do not feel disposed to buy the entire Series, it will be possible to secure half the Series, making 43 volumes, for £7 cash, or £7 7s. on the instalment system, the purchaser himself selecting the volumes. The whole Series or half, as the case may be, will be sent on receipt of the first payment of One Guinea—the rest to be paid at the rate of £1 1s. per month.

NOTE:—OFFER OPEN ONLY FOR A SHORT TIME.
ORDER AT ONCE.

A Set of the Volumes may be seen at the Office of NATURE, ST. MARTIN'S STREET, W.C.

A Pamphlet, giving titles, &c., of the Works in the Series, Specimen Pages, with Illustrations, of some of the Volumes, also Order Form, will be sent Post Free on application to

C. WORSFOLD, "NATURE" Office, St. Martin's Street, London, W.C.

ORDER FORM.

Date.....1900.

All cheques should be crossed and made payable to C. WORSFOLD, "NATURE" Office, St. Martin's Street, W.C.

I enclose One Guinea as first payment for "NATURE'S Re-issue of the International Scientific Series," and I agree to pay to you, or your representative, the balance at the rate of One Guinea per month; my next payment to be on delivery of the volumes, and my remaining payments on the corresponding day of each month following.

Until such payments are complete, I engage that the Works, not being my property, shall not be disposed of by sale or otherwise.

I further agree that if it be found impossible for any reason to deliver the books, the return of the sum of One Guinea to me shall cancel this agreement.

Name.....

Address.....

Residents abroad are kindly requested to remit in full, or to instruct their representatives in England to make the monthly payments, in order to avoid the expense and delay in forwarding cash from abroad.

The... 'N. & G.' Cameras

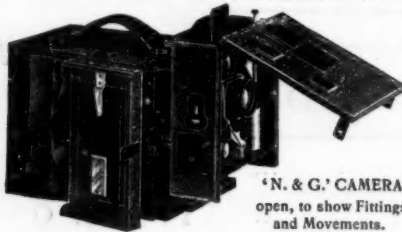
In all sizes up to 7 x 5 in.
For Plates, Cut Films, or Film
in Spools.

For Hand and Tripod.

A Series of High-Class Instruments for Serious Work,
embodying every New Advance in Photography.

Prices from £13 to £50.

Have been in Constant Use for Eight Years in all parts of the World.



'N. & G.' CAMERA,
open, to show Fittings
and Movements.

TRIPOD CAMERAS, SURVEYING CAMERAS, and very Small and
Light POCKET CAMERAS for Travellers and Field Naturalists.

Speciality: COMPLETE OUTFITS for Scientific Expedi-
tions and Special Research.

Catalogues and Estimates Lenses, Kinematographs, Lanterns, and all
free on application. Photographic Accessories and Materials.

Newman & Guardia, Ltd.

90 & 92 Shaftesbury Avenue, London, W.

W. WILSON,

Makers of

SPECTROSCOPES, SPECTROMETERS,
GONIOMETERS,
OPTICAL BENCHES, OPTICAL AND OTHER
MEASURING INSTRUMENTS.

BEST WORK. MODERATE PRICES.

Price List Free.

1, BELMONT STREET, CHALK FARM, N.W.

JAS. SWIFT & SON,

MANUFACTURING OPTICIANS.

SOLELY APPOINTED TO THE A.M. DEPT.
WAR OFFICE, FOR THE SUPPLY
OF MICROSCOPES.

Patent form of Student's Microscope,
fitted with $2\frac{1}{3}$ " and $1\frac{1}{8}$ " Pan-Aplanatic
Objectives, Iris Diaphragm and Oculars,
in Case, from

£5 5s.

These Instruments we have supplied in
numbers to the following Medical Schools,
viz. St. Mary's, St. Bartholomew's, Guy's,
Middlesex, London, and St. Thomas's.
Seven Gold Medals awarded for excel-
lence of manufacture.

Catalogue on Application.



81 TOTTENHAM COURT ROAD, W.

OPPOSITE THE BRITISH MUSEUM.

THACKERAY HOTEL

(TEMPERANCE),

GREAT RUSSELL STREET, LONDON.

THIS newly-erected and commodious Hotel will, it is believed, meet the requirements of those who desire all the conveniences and advantages of the larger modern licensed hotels at moderate charges. Passenger Lift. Electric Light in all Rooms. Bath-rooms on every Floor. Spacious Dining, Drawing, Writing, Reading, and Smoking Rooms. All Floors Fireproof. Perfect Sanitation. Night Porter. Telephone. Bedrooms from 2s. 6d. to 4s. 6d. per night. Full Tariff and Testimonials on application.

Telegraphic Address: "THACKERAY, LONDON."

Proprietor—J. TRUSLOVE.

Also, amalgamated with, and under the same management,

ESMOND HOTEL

(TEMPERANCE),

MONTAGUE STREET, RUSSELL SQUARE.

THIS Hotel, which has been carried on so successfully for the last 13 years, adjoins the British Museum, and is exception-
ally quiet. Bedrooms from 2s. to 3s. 6d. per night. Full Tariff and Testimonials on application.

Telegraphic Address: "TRUSLOVE, LONDON."

Proprietor—J. TRUSLOVE.

TO SCIENTIFIC MEN, NATURALISTS, TRAVELLERS, AND OTHERS.

THE STEREOSCOPIC COMPANY

CAN SPECIALLY
RECOMMEND ANY OF
THE FOLLOWING
HAND CAMERAS.



Address—
106 & 108 REGENT ST., W.,
and 54, Cheapside, E.C.

THE TWIN-LENS ARTIST,

with full size Focussing
Finder, Rapid Euryscope
Lenses, Time and Instanta-
neous Shutter, Rising Front,
Focussing Adjustment,
Double Dark Slides,
Magazine or Cartridge
Roll Holders.

1-p. complete, with £ 2.
3 Slides ... 14 14
5x4 complete, with
3 Slides ... 16 16
1-p. complete, with
3 Slides ... 21 0

THE TWIN-LENS ARTIST,

with
MAGAZINE
for 12 Plates or
24 Films,
&c., &c.,
as described.

1-p. complete... £ 2.
15 15
5x4 " ... 17 17
1-p. " ... 22 3

THE! TWIN-LENS CARLTON,

Carrying 12 Plates
or Films,
and now so well known
as not to
need description.

PRICE: £ 4.
1-p. complete... 12 12
5x4 " ... 15 15
1-p. " ... 21 0

PLEASE READ

Extract of Letter from
R. BOWDLER SHARPE,
Esq., LL.D.,
Assist. Keeper Zoological
Dept., British Museum,
March 4, 1898:—

"I consider it one of the
best day's work I ever did
when I bought one of your
Cameras. The ease with
which it is worked, and the
excellent results obtained,
make it a most pleasurable
accompaniment of a summer's
outing."

FREE LESSONS TO
PURCHASERS.

GENERAL LIBRARY,
UNIV. OF MICH.
MAR 21 1900



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 1584, VOL. 61]

THURSDAY, MARCH 8, 1900.

[PRICE SIXPENCE.]

Registered as a Newspaper at the General Post Office.]

[All Rights are Reserved.]

PHASE-REVERSAL ZONE-PLATES,

As described by Prof. R. W. Wood at the Society of Arts.

180 c/m Focus for use as Object-glass, with Telescope Eye-piece to show multiple foci of plate, or for showing the multiple foci in projection on a Screen.

65 c/m Focus for use as a Telescope Object-glass, with a 13 c/m Focus Zone-plate as an Eye-piece.

13 c/m Focus for use as an Eye-piece in connection with longer focus plates, or for photographing Landscapes without using a lens.

Price 10s. each.

Directions sent with each Zone-plate.

Black and white, transparent phase-reversal, and silver on glass zone-plates, can be supplied to order of any focus desired.

PRISMS OF SOLID CYANINE.

For showing anomalous dispersion, as described by Prof. R. W. Wood in *Phil. Mag.*, October 1898.

Price 7s. 6d. each.

Photographic Gratings made by Prof. R. W. Wood, 7s. 6d. each.

The above can be obtained only from—

NEWTON & CO., 3 Fleet Street, London.

BECK'S NEW MICROSCOPE THE "BRITISH STUDENTS."

Microscope Stand No. 55, as figured, with Iris Diaphragm, One Eye-piece; Double Nose-piece, Two Object-glasses, 2/3" and 1/8", adjusted to be in about focus, and the whole packed in polished Mahogany Case.

£6 : 8 : 6

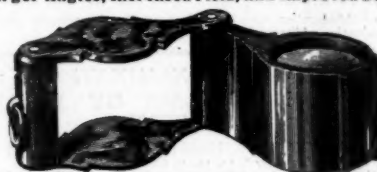
No. 55.



R. & J. BECK, Ltd.,
68 CORNHILL, LONDON, E.C.

BROWNING'S PLATYSCOPIC LENS.

With Larger Angles, Increased Field, and Improved Definition.



Engraved Real Size.

AN ACHROMATIC COMBINATION,

COMBINING THE DEFINITION OF A MICROSCOPE WITH THE PORTABILITY OF A POCKET LENS.

"If you carry a small Platyscopic Pocket Lens (which every observer of Nature ought to do)."—GRANT ALLEN in *Knowledge*.

The Platyscopic Lens is invaluable to botanists, mineralogists, or entomologists, as it focuses about three times as far from the object as the Coddington Lenses. This allows opaque objects to be examined easily.

The Platyscopic Lens is made of four degrees of power, magnifying respectively 10, 15, 20, and 30 diams.; the lowest power, having the largest field, is the best adapted for general use.

The Lenses are set in Ebony Cells, and mounted in Tortoiseshell Frames. Price of the Platyscopic Lens, mounted in Tortoiseshell, magnifying either 10, 15, 20, or 30 diameters, each power, 15s.

In nickelised German Silver, each power, 17s. 6d.

Illustrated Description sent free.

JOHN BROWNING, 63 STRAND, LONDON, W.C.

NEGRETTE & ZAMBRA'S LONG RANGE BINOCULARS AND TELESCOPES FOR MILITARY PURPOSES.

ILLUSTRATED PRICE LISTS FREE BY POST TO ALL PARTS OF THE WORLD.

SPECIAL TERMS TO YEOMANRY TROOPS AND VOLUNTEER CORPS REQUIRING SEVERAL GLASSES.



THE "READY-FOCUS" BINOCULAR.

A great improvement over the ordinary system of Focussing.

Invaluable in watching moving objects.

NEGRETTE & ZAMBRA,

SCIENTIFIC INSTRUMENT MAKERS TO THE QUEEN,
38 HOLBORN VIADUCT, E.C.

BRANCHES: 45 CORNHILL; 122 REGENT STREET.

THE DAVY-FARADAY RESEARCH LABORATORY

OF THE

ROYAL INSTITUTION.

DIRECTORS:

The Right Hon. LORD RAYLEIGH, M.A., D.C.L.,
LL.D., F.R.S.

Professor DEWAR, M.A., LL.D., F.R.S.

SUPERINTENDENT OF THE LABORATORY:

Dr. ALEXANDER SCOTT, M.A., D.Sc., F.R.S.

This Laboratory was founded by Dr. Ludwig Mond, F.R.S., as a Memorial of Davy and Faraday, for the purpose of promoting, by original research, the development and extension of Chemical and Physical Science.

The Laboratory is open free of charge to Workers of either sex, and any nationality, prosecuting individual investigations; and the extensive collection of Physico-Chemical Apparatus presented by the Founder is available for their use, together with such materials, chemicals, electricity, &c., as the Directors may authorise.

Assistants and a trained mechanic are attached to the Laboratory to aid Workers in the prosecution of their researches.

All persons desiring to be admitted as Workers must send evidence of scientific training, qualification, and previous experience in original research, along with a statement of the nature of the investigation they propose to undertake.

Christmas Term.—Monday, October 9, to Saturday, December 16.

Lent Term.—Monday, January 8, to Saturday, April 7.

Easter Term.—Monday, April 30, to Saturday, July 28.

Forms of Application can be had from the ASSISTANT SECRETARY, Royal Institution, Albemarle Street, W.

TECHNOLOGICAL EXAMINATIONS, 1900.

CITY AND GUILDS OF LONDON INSTITUTE.

The Institute's EXAMINATIONS in TECHNOLOGY will be held on April 30; May 1, 2, 3, 5, 7, 8, 11, 12, 19 and 20.

All applications from Local Secretaries for Examination in Technology must be forwarded to the Institute on or before March 26.

Only in exceptional cases, and by payment of an additional fee, can application be received from Local Secretaries after that date.

Candidates in Technology not attending any registered class should apply at once to the Secretary at the nearest local centre.

Applications from any individual Candidates for Examination at the Offices of the Institute should be made not later than April 9, and should state clearly the subject and grade of examination. Applications should be addressed to the Examinations Department, City and Guilds of London Institute, Exhibition Road, London, S.W., and should be accompanied by a postal order for the amount of the fee.

CIVIL SERVICE COMMISSION.

FORTHCOMING EXAMINATION.

DRAUGHTSMAN in the Hydrographic Department of the Admiralty (17-23), 13th March. Expertness in Hydrographical Chart Drawing essential.

The date specified is the latest at which applications can be received. They must be made on forms to be obtained, with particulars, from the SECRETARY, Civil Service Commission, London, S.W.

WANTED, for the National Physical

Laboratory, a LABORATORY ASSISTANT and MECHANIC. Applicants should have had experience both in an Instrument Maker's Shop and in a Laboratory. Some knowledge of Glass-blowing and Pattern making is also desirable. Applications, stating age, qualifications and salary required, and giving references, should be made by letter addressed to the DIRECTOR, National Physical Laboratory, Old Deer Park, Richmond.

The ADVERTISER is desirous of seeing or communicating with any one who has an invention connected with Incandescent Gas Lighting, with a view to the bringing out or sale of the invention.—"A. B.," 30 Watling Street, E.C.

BIRKBECK INSTITUTION,

Breams Buildings, Chancery Lane, E.C.

Science Classes with Practical Work.

DAY AND EVENING CLASSES for University of London B.Sc.; Prelim. Scientific, Inter. M.B. Examinations and for Conjoint Board, Dental and Pharmaceutical Examinations.

EVENING CLASSES in all stages for Science and Art Department Examinations.

HIGHLY-EQUIPPED LABORATORIES.

Chemistry, Physics, Biology (Zoology and Botany), Metallurgy, Geology and Mineralogy, Microscopy.

Prospectus free. Calendar 6d. (Post 8d.) on application to Secretary.

HEATHCOTE SCIENCE LABORATORIES.

These Laboratories are open for RESEARCH work, at any hours or times most convenient for worker, in CHEMISTRY, PHYSICS and BACTERIOLOGY. Facilities for Commercial investigations are supplied.

Furnaces and powerful Electrical Currents can be used. The Fees are at rate of £3 3s. for one month (five days a week, six hours a day). Apparatus supplied free.

Private Laboratory, £4 14s. 6d. a month, or by arrangement.

The above Fees include use of all ordinary Glass and other Apparatus, and use of Accurate Balances and Standard General Instruments, also Furnaces, &c.

9 Heathcote Street, Mecklenburgh Square,
Gray's Inn Road, W.C.

R. C. F. EVANS,
Director.

Advertiser, 31, Bachelor, much attached to

Study of Natural History, Fellow of Learned Societies, Author of well-spoken of Book—"remarkable for truly Darwinian qualities of thoroughness and caution" (*Saturday Review*), desires employment in Library, Museum, or otherwise. Could accept moderate salary.—Write, "B. A.," 54 New Oxford Street, W.C.

FOR SALE BY ORDER OF THE EXORS.

The unique MICROSCOPIC SPECIMENS COLLECTED BY THE LATE

MR. H. VIRTUE TEBBS.

Selections can be made at

C. BAKER'S, 244 HIGH HOLBORN, LONDON.

Telegrams—Optivorum, London. Telephone—1497, Holborn.

A BECK MICROSCOPE, costing over

£90, TO BE SOLD FOR HALF. International Stand, with a quantity of Fittings; condition as new. On View.—Apply, "A. R. K.," 742 Holloway Road, N.

LETCHER & SONS (formerly Letcher Bros.),

SCIENTIFIC INSTRUMENT MAKERS,

25 TURNPIKE LANE, HORNSEY, N.

BLOWPIPE CABINETS. SPECIALITY: SOCIETY OF ARTS SETS.

BOTANICAL MATERIAL FOR CLASS WORK, RESEARCH AND PRIVATE STUDENTS.

J. BACKHOUSE & SON, LIMITED, YORK.
Having now established their new Scientific Department and Experimental Laboratory, are prepared to send Post free on application their new

50 PAGE CATALOGUE,

comprising Cryptogamic and Phanerogamic Material, fresh or preserved; Museum Specimens; Microscopical Preparations; &c., &c

BARGAINS IN SCIENTIFIC BOOKS.

BEDDARD, M.A. (FRANK E.), ANIMAL COLORATION. An Account of the Principal Facts and Theories relating to the Colours and Markings of Animals. With 4 Coloured Plates and Woodcuts in the Text, Demy 8vo, Cloth (6s.). 2s. 9d.

McALPINE (Prof. D.), BIOLOGICAL ATLAS—A GUIDE TO THE PRACTICAL STUDY OF PLANTS AND ANIMALS, adapted to the Requirements of the London University, Science and Art Department, and for Use in Schools and Colleges, containing 24 Plates, with 423 Coloured Figures and Diagrams, with Text giving Arrangement and Explanation, Equivalent Terms, Glossary, and Classification, Royal 4to, Half Cloth (7s. 6d.). 1s. 9d.

COLE, F.R.M.S. (A. C.), THE METHODS OF MICROSCOPICAL RESEARCH, A PRACTICAL GUIDE TO MICROSCOPICAL MANIPULATION. Second Edition, much Enlarged, 8vo, Cloth (6s.). 1s. 6d.

SANDFORD (E.), A MANUAL OF EXOTIC FERNS AND SELAGINELLA. Comprising descriptions of over 1000 Species and Varieties, and upwards of 600 Synonyms, also Notes on their History, Culture and Management. Crown 8vo, Cloth (6s. 6d.). 1s. 3d.

BRITTEN, F.L.S. (JAMES), EUROPEAN FERNS, THEIR FORM, HABIT AND CULTURE. With 30 Facsimile Coloured Plates, Painted from Nature by D. BLAIR, F.L.S., Demy 4to, Cloth (21s.). 7s.

NEWMAN, F.Z.S. (EDWARD), BRITISH BUTTERFLIES AND MOTHS. Illustrated with nearly 900 Life-size Figures of Species of Butterflies and Moths. Super Royal 8vo, Cloth, Gilt Edges (25s.). 12s.

Postage 4d. extra on one, or 6d. on two.

H. J. GLAISHER, New and Remainder Bookseller, 57 Wigmore Street, London, W.

Catalogues Post Free on application.

THE GEOGRAPHICAL JOURNAL.

Price 2s. CONTENTS.—MARCH.

A Fragment of the Geography of England: South-West Sussex. By Hugh Robert Mill, D.Sc., F.R.S.E.

A Journey from Fort Jameson to Old Chitambo and the Tanganyika Plateau. By Robert Codrington, Deputy Administrator, Northern Rhodesia.

The "Sudd" of the White Nile.

Military Geography. By Col. Sir T. H. Holdich, K.C.I.E., C.B., R.E.

Narrative of a Journey to the Lakes Rakas-Tal and Manasarowar, in Western Tibet, undertaken in September, 1898. By Lieut.-General Sir Richard Strachey, R.E., G.C.S.I., F.R.S.

A Journey through Abyssinia to the Nile. By Hugh Weld Blundell.

The Danish *Ingo* Expedition.

The Monthly Record.

Obituary: The Marquis of Lothian, K.T.; Sir William Wilson Hunter, K.C.S.I., C.I.E.; Sir Henry William Gore-Booth, Bart.; M. Henri Coudreau.

Correspondence: The Regions of the Okovango. By Fred. S. Arnot.

Lake Kukuwa. By L. A. Wallace.

Meetings of the Royal Geographical Society, Session 1899-1900.

Geographical Literature of the Month.

Numerous Maps and Illustrations.

EDWARD STANFORD, 26-27 Cockspur Street, Charing Cross, S.W.

Now Ready, 8vo, Price 6s. net.

RECENT & COMING ECLIPSES.

BY

SIR NORMAN LOCKYER, K.C.B., F.R.S.

Second Edition, containing an account of the observations made at Viziadrag, in India, in 1898, and of the conditions of the Eclipses visible in 1900, 1901 and 1905.

MACMILLAN AND CO., LTD., LONDON.

OXFORD UNIVERSITY PRESS.

Now Ready, 8vo, pp. 248, cloth, with a Portrait of Prof. JOHN SIBTHORP; price Six Shillings.

THE PHYSICAL PROPERTIES OF SOIL.

LECTURES by ROBERT WARINGTON,
M.A., F.R.S.,

Formerly Sibthorpe Professor of Rural Economy in the University of Oxford; Examiner in the Principles of Agriculture to the Department of Science and Art.

Just Published, Vol. I, pp. xii + 632, with many Illustrations. Royal 8vo, half-morocco, price Twenty-eight Shillings.

The PHYSIOLOGY of PLANTS.

A TREATISE UPON THE METABOLISM AND SOURCES OF ENERGY IN PLANTS.

By **Dr. W. PFEFFER,**

PROFESSOR OF BOTANY IN THE UNIVERSITY OF LEIPZIG.

SECOND FULLY REVISED EDITION.

Translated and Edited by

ALFRED J. EWART, D.Sc., Ph.D., F.L.S.

LONDON: HENRY FROWDE, OXFORD UNIVERSITY PRESS, AMEN CORNER, E.C.

MR. EDWARD ARNOLD'S LIST.

ELEMENTARY NATURAL PHILOSOPHY. By ALFRED EARL, M.A., Assistant Master at Tonbridge School. With numerous Illustrations and Diagrams. Cloth, 4s. 6d.

A TEXT-BOOK OF PHYSICAL CHEMISTRY. By Dr. R. A. LEHFELDT, Professor of Physics at the East London Technical College. Crown 8vo, Cloth, 7s. 6d.

MAGNETISM AND ELECTRICITY. By J. PALEY YORKE, of the N. Polytechnic Institute. Crown 8vo, 3s. 6d.

A MANUAL OF PHYSIOLOGY. By LEONARD HILL, M.B., Lecturer in Physiology at the London Hospital Medical College. With numerous Illustrations and Diagrams. 6s.

LECTURES ON THEORETICAL AND PHYSICAL CHEMISTRY. Part I. CHEMICAL DYNAMICS. By Dr. J. H. VAN 'T HOFF. Translated by Dr. R. A. LEHFELDT, Professor at the E. London Tech. Coll. One vol. Demy 8vo, 12s. net.

STEAM BOILERS. By George Halliday. With numerous Diagrams and Illustrations. 400 pages. Crown 8vo, 5s.

ELECTRICAL TRACTION. By Ernest WILSON, Wh.Sc., M.I.E.E., Professor of Electrical Engineering in the Siemens Laboratory, King's College, London. Crown 8vo, Cloth, 5s.

PHYSICAL GEOGRAPHY. By WILLIAM M. DAVIS, Professor of Physical Geography in Harvard University, assisted by WILLIAM H. SNYDER, Master in Science in Worcester Academy. 12mo., Cloth, 428 pages, Illustrated, 5s. 6d.

THE ELEMENTS OF EUCLID, Books I.-VI. By R. LACHLAN, Sc.D., formerly Fellow of Trinity College, Cambridge. With alternative Proofs, Notes, Exercises, and a large collection of Riders and Problems. Crown 8vo, Cloth, 4s. 6d.

THE ELEMENTS OF ALGEBRA. By R. LACHLAN, Sc.D., formerly Fellow of Trinity College, Cambridge. Crown 8vo, Cloth, with or without Answers, 2s. 6d. Answers separately, 1s.

HABIT AND INSTINCT: a Study in Heredity. By C. LLOYD MORGAN, F.R.S., Principal of University College, Bristol, Author of "Animal Life and Intelligence," &c. Demy 8vo, 16s.

THE CALCULUS FOR ENGINEERS. By Prof. JOHN PERRY, F.R.S. Third Edition. Crown 8vo, Cloth, 7s. 6d.

London: EDWARD ARNOLD, 37 Bedford Street, Strand.

UNIVERSITY OF LONDON.

NOTICE IS HEREBY GIVEN, that on WEDNESDAY, 25th of APRIL next, the Senate will proceed to elect Examiners in the following Departments for the year commencing July 1, 1900:—

Examinerships.	Salaries.	Present Examiners.
ARTS AND SCIENCE.	(Each.)	
Two in Latin	200	{ Prof. J. P. Postgate, M.A., Litt.D. Prof. J. S. Reid, M.A., Litt.D.
Two in Greek	140	{ G. E. Marindin, Esq., M.A. Vacant.
Two in the English Language and Literature	150	{ Prof. J. W. Hales, M.A. Prof. A. S. Napier, Ph.D., M.A.
Two in History	100	{ S. R. Gardiner, Esq., D.C.L. Prof. F. York Powell, M.A.
Two in the French Language and Literature	130	{ James Botelle, Esq., B.A. Prof. Frederic Spencer, Ph.D., M.A.
Two in the German Language and Literature	80	{ E. L. Milner-Barry, Esq., M.A. Vacant.
Two in the Hebrew Text of the Old Testament, the Greek Text of the New Testament, the Evidences of the Christian Religion, and Scripture History	50	{ Rev. C. F. Burney, M.A. J. F. Stenning, Esq., M.A.
Two in Mental and Moral Science	120	{ Prof. S. Alexander, M.A. Prof. G. F. Stout, M.A.
Two in Political Economy	60	{ Prof. C. F. Bastable, M.A. Prof. W. A. S. Hewins, M.A.
Two in The Art, Theory, and History of Teaching	25	{ Prof. James Sully, M.A., LL.D. Oscar Browning, Esq., M.A.
Two in Mathematics and Natural Philosophy	200	{ Joseph Larmor, Esq., D.Sc., M.A., F.R.S. Vacant.
Two in Experimental Philosophy	210	{ Prof. G. F. Fitzgerald, M.A., F.R.S. Prof. Silvanus Thompson, D.Sc., B.A., F.R.S.
Two in Chemistry	240	{ Prof. William Ramsay, Ph.D., LL.D., F.R.S. Prof. Percy F. Frankland, Ph.D., B.Sc., F.R.S.
Two in Botany and Vegetable Physiology	135	{ Prof. F. W. Oliver, M.A., D.Sc. Vacant.
Two in Comparative Anatomy and Zoology	120	{ Prof. G. B. Howes, LL.D., F.R.S. Vacant.
Two in Geology and Physical Geography	75	{ Prof. Charles Lapworth, LL.D., F.R.S. Vacant.
LAWS.		
Two in Jurisprudence, Roman Law, Principles of Legislation, and International Law	100	{ Prof. J. Pawley Bate, LL.D., M.A. Vacant.
Two in Equity and Real and Personal Property	50	{ E. J. Elgood, Esq., B.C.L., M.A. T. Cyprian Williams, Esq., LL.B.
Two in Common Law and Law and Principles of Evidence	50	{ Hugh Fraser, Esq., M.A., LL.D. W. Blake Odgers, Esq., LL.D., M.A., Q.C.
Two in Constitutional History of England	25	{ S. H. Leonard, Esq., M.A., B.C.L. Prof. F. C. Montague, M.A.
MEDICINE.		
Two in Medicine	210	{ W. H. Allchin, Esq., M.D. Frederick Taylor, Esq., M.D.
Two in Surgery	200	{ W. Watson Cheyne, Esq., M.B., C.M., F.R.C.S. Vacant.
Two in Anatomy	150	{ Prof. G. D. Thane. Prof. A. H. Young, M.B.
Two in Physiology	140	{ Prof. J. G. McKendrick, M.D., F.R.S. Prof. E. A. Schäfer, LL.D., F.R.S.
Two in Obstetric Medicine	105	{ Sir John Williams, Bart., M.D. Vacant.
Two in Materia Medica and Pharmaceutical Chemistry	100	{ D. J. Leech, Esq., M.D. Vacant.
Two in Forensic Medicine	80	{ Prof. J. Dixon Mann, M.D. Thomas Stevenson, Esq., M.D.
Two in State Medicine	30	{ Arthur Newsholme, Esq., M.D. Vacant.
Two in Mental Physiology	25	{ Prof. S. Alexander, M.A. Vacant.
MUSIC.		
Two in Music	50	{ C. H. Lloyd, Esq., Mus.Doc., M.A. Vacant.

The Examiners above named are re-eligible, and intend to offer themselves for re-election.

Candidates must send in their names to the Registrar, with any attestation of their qualifications they may think desirable, on or before TUESDAY, MARCH 27. (It is particularly desired by the Senate that no application of any kind be made to its individual Members.)

University of London,
Burlington Gardens, W.,
March 7, 1900.

By order of the Senate,
F. VICTOR DICKINS, M.B., B.Sc.,
Registrar.

Sale by Auction.

PRELIMINARY NOTICE.
TUESDAY AND WEDNESDAY, MARCH 27 and 28.
THE "SAMUEL STEVENS" COLLECTION.

MR. J. C. STEVENS begs to announce that he has received instructions from the Executors to Sell by Auction, at his Great Rooms, 38 King Street, Covent Garden, on Tuesday and Wednesday, March 27 and 28, the well-known Collection of British Lepidoptera, formed by the late SAMUEL STEVENS, Esq., the result of over sixty years' collecting and breeding; consisting probably of over 100,000 specimens, and amongst them some wonderful and exceptional varieties of a very large number of species, and a long series of many rare and extinct species too numerous to mention.

On view day prior, to till 4. Catalogue in preparation, and can be had on application.

GLASS BLOWING.

All kinds of Experimental Glass Blowing carried out for Scientific Men, Laboratories, &c.

INVENTORS' IDEAS WORKED OUT AS PER INSTRUCTIONS.

COSSOR,

67 Farringdon Road, E.C.

THE SCIENTIFIC ROLL AND MAGAZINE OF SYSTEMATIZED NOTES.

THIS WORK IS A VALUABLE GUIDE, BIBLIOGRAPHY, AND INDEX TO SCIENCE.

BACTERIA (Botanical Section).

Although these are the simplest of plants, there is probably no group of organisms which exceeds them in interest or importance. Their operations affect the welfare of every member of the community, as also of the whole organic world. A full knowledge of them is essential in all questions bearing upon public and private health, agriculture, the microbial diseases of animals and of plants; and it is important in many industries, such as those dealing with milk, butter, hay, flax, tobacco, and others.

The group will be dealt with in three octavo volumes of about 500 pp. each. The subscription price will be 10s. for each volume, payable on delivery of the first number of the volume; or arrangements may be made to supply only the portions relating to a particular species, genus, or topic, at a proportionately reduced rate. The first volume will be commenced next summer, and if sufficient subscribers support the work, the three volumes will be completed in three years. As all the matter will be systematized, the series will be equivalent to a good bacteriological library, with the advantage that the information on any particular point will be comprised within a comparatively few pages, and not scattered over thousands of pages in a host of journals and books.

The names and addresses of subscribers, and applications for prospectus may be sent to the undersigned.

The undersigned will be glad to hear from PRINTERS willing to give estimates for printing, and from PUBLISHERS willing to consider terms for publishing the above-mentioned work.

A. RAMSAY,
4 Cowper Road, Acton, London, W.

Recently Published.

INSECTS: Their Structure & Life.

A PRIMER ON ENTOMOLOGY.

By GEORGE H. CARPENTER, B.Sc.Lond.

Cloth Gilt, 4s. 6d. net.

Knowledge says: "The beginner will here find an elementary account of the chief characteristics of insect life and habits which is altogether trustworthy."

Science Gossip says: "We can recommend Mr. Carpenter's little work as one well worth perusal, and one likely to be useful to its readers."

J. M. DENT & CO., 29 and 30 Bedford Street, W.C.

TO SCIENCE LECTURERS. HUGHES' MOTO-PHOTOSCOPE FOR LIVING PICTURES. THE MOST PERFECT.

No SHUTTER, therefore no Flickering. Superb Mechanism. The Moto-Photo Camera for taking the Pictures. Illustrated Lists, 2d. See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN, &c. Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great success. New Oxhydrogen Microscope. Science Lanterns for Class Demonstration. Magnificent Results. Docwra Triple, Prize Medals Highest Award. Supplied to the Royal Polytechnic Institution, Dr. H. GRATTAN GUINNESS, Madame ADELINA PATTI, &c., &c. Patent Pampengo, Science Lanterns. The Universal Lantern 4-inch Condensers, 4-wick Lamp, Portrait Combination front Lenses, 18s. 6d., Marvellous value. Science Lecture Sets. Novelties. The Lantern Kaleidoscope. Cheapest Lantern Outfits in the World. Grandly Illustrated Catalogue, over 180 choice Engravings, 6d.; Postage, 3d. List of 300 Lecture Sets, Science Subjects, Views, &c., 6d.; Postage 2d. Pamphlets Free. W. C. HUGHES, SPECIALIST, Brewster House, 82 Mortimer Road, Kingsland, N.

Apparatus for estimation of sulphur in spent oxide.



FREDK. JACKSON & Co.

(Late MOTTERSHEAD & CO.),
14 CROSS STREET, MANCHESTER.

Goods Entrance: 10 Half-Moon Street,

LABORATORY FURNISHERS,

Importers, Manufacturers, and Dealers in
CHEMICAL AND PHYSICAL
APPARATUS

Of every Description.

Fine Chemicals, Volumetric Solutions,
Plain and Stoppered Bottles,

AND EVERY LABORATORY REQUIREMENT.
Illustrated Catalogue of Apparatus, with Price List
of Chemicals, free on application.

Telegraphic Address—"APPARATUS, MANCHESTER."
Telephone Number—2038.

CHEAP SPECTROSCOPES

(a) **STUDENT'S SPECTROSCOPE**; comprising a Prism
of Dense Flint, Telescope and Collimator with $7\frac{1}{2}$ " Focus Object
Glasses, Circle divided over 90° to $5'$ of Arc, Slit with Non-corrosive
Jaws and Screw Adjustment. Mounted on Strong Iron Trip.

Price £5 0 0

(b) **STUDENT'S SPECTROSCOPE**; do., do., with $9"$
Focus Achromatic Object Glasses. Also Rotating Prism Table,
and Tilting Adjustments to Telescope and Collimator.

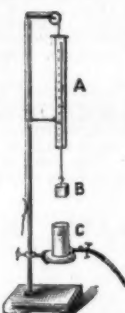
Price £6 10 0

(c) **SOUTH KENSINGTON TYPE TABLE SPEC-**
TROSCOPE; comprising Prism of Dense Flint $1\frac{1}{2}"$ high by $1\frac{1}{2}"$
length of Face, Telescope and Collimator with $1\frac{1}{2}"$ clear Aperture, and
 $11\frac{1}{2}"$ Focus Achromatic Object Glasses, Circle divided all round to
read to $1'$ of Arc, Slit with Non-corrosive Jaws and Screw
Adjustment, Comparison Prism, Wedge for reducing the
Aperture, and divided Drumhead to Screw Adjustment.
Telescope has slow motion by Tangent Screw. The Prism Table
rotates, and there are Tilting Adjustments to Telescope and Collimator.

Price £8 0 0

ADAM HILGER, 204 Stanhope St., London, N.W.

MOORE'S HYDROSTATIC BALANCE



FOR ILLUSTRATING THE "PRINCIPLE OF
ARCHIMEDES" AND SPECIFIC GRAVITY.

A is a delicate spring balance accurately graduated to
read Grams, and is capable of being lowered or raised
by the string shown.

B is one of the set of cubes of various metals supplied
with the apparatus.

C is a glass vessel with fixed mark etched in glass, up
to which water, or other liquid, is placed. The
vessel is provided with draw-off cock.

Sole Makers of this Apparatus—

BREWSTER, SMITH, & CO.,
6 CROSS STREET, FINSBURY, E.C.

Manufacturers and Importers of Chemical and Scientific
Apparatus and Pure Chemicals.

WEIGHTS a Speciality, 500 Milligrams to
1 Milligram, 12. 6d. per doz.

SEND FOR COMPLETE ILLUSTRATED
CATALOGUE.



CARL ZEISS,

OPTICAL WORKS, JENA.

LONDON BRANCH:

29 MARGARET ST., REGENT ST., W.

NEW

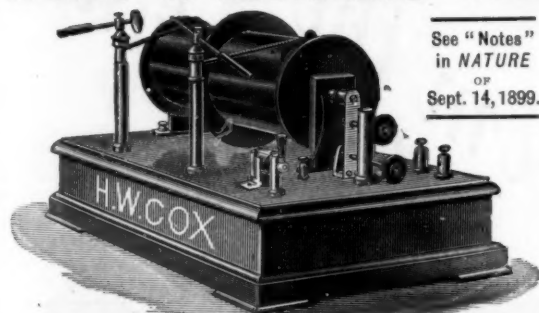
PHOTO-MICROGRAPHIC STAND

With very wide body-tube specially
designed for working with our MICRO-
PLANARS. It is also fitted with a new
Fine-Adjustment of great accuracy and
possessing a very slow movement.

These features render this Microscope
pre-eminently suitable for Photo-micro-
graphy with the highest and lowest powers,
as well as for ordinary visual observations.

DESCRIPTIVE PAMPHLET FREE ON APPLICATION.

X-RAY & ÆTHERIC TELEGRAPHY APPARATUS



See "Notes"
in NATURE

OF
Sept. 14, 1899.

OF THE HIGHEST QUALITY AND FINISH ONLY,
As supplied by us to H.M. Government and the leading
Hospitals and X-Ray Workers throughout the World.

We are the actual Manufacturers, and Guarantee
every Coil against breaking down.

CALL OR WRITE FOR OUR NEW ILLUSTRATED LIST, WITH
TESTIMONIALS AND ILLUSTRATED INSTRUCTIONS UPON HOW
TO WORK. POST FREE TO READERS OF "NATURE."

HARRY W. COX, Ltd.,

10, 11, 28 CURSITOR STREET,

CHANCERY LANE, LONDON.

Radiographs taken for Scientific and Medical Men, and
Demonstrations given.

HARVEY & PEAK

(BY APPOINTMENT TO THE ROYAL INSTITUTION OF GREAT BRITAIN)

HAVE FOR DISPOSAL A NUMBER OF

NICOL PRISMS AND TOURMALINES of various Sizes.

PROJECTION POLARISCOPES of various Sizes in Stock, with large Nicol Prisms:—

STUDENTS' SPECTROMETERS.—P. O. Bridge Sets, for Schools.—Induction Coils.—Wimshurst Machines.—
X-Ray Apparatus.—Optical Banks, &c., &c.

H. & P. are the actual Manufacturers of the above.

56 CHARING CROSS ROAD, LONDON, W.C.

CHARLES GRIFFIN AND CO.'S PUBLICATIONS.**ELECTRICAL RULES AND TABLES**

(A Pocket-book of). For the use of Electricians and Engineers. By J. MUNRO, C.E., and Prof. JAMIESON, M.Inst.C.E., F.R.S.E. Fourteenth Edition. Revised and Enlarged. With Additional Notes, by Prof. S. P. THOMPSON on Dynamo Design, &c. Pocket size. With Diagrams. 8s. 6d.

"Worthy of the highest commendation."—*Electrician*.

THE MINING ENGINEERS' REPORT

BOOK AND DIRECTORS' AND SHAREHOLDERS' GUIDE TO MINING REPORTS. By EDWIN R. FIELD, M.Inst.M.M. Pocket size, strongly bound in Leather. 3s. 6d. With Notes on Valuation of Property, Tables, &c., and detachable blank pages for MS. Notes.

"A valuable guide."—*Mining Journal*.

PROSPECTING FOR MINERALS. A

Practical Handbook for Mining Engineers and others. By S. HERBERT COX, Assoc. R.S.M., M.Inst.M.M., F.G.S., &c. With Illustrations. Second Edition, Revised. Cloth, 5s.; Leather, 6s. 6d.

"This admirable little work."—*Mining Journal*.

Large 8vo, Handsome Cloth, Ready Immediately.

THE METALLURGY OF LEAD AND SILVER.

By H. F. COLLINS, Assoc. R.S.M., M.Inst.M.M.

Part II.—SILVER.

Comprising Details Regarding the

SOURCES AND TREATMENT OF SILVER ORES,

TOGETHER WITH DESCRIPTIONS OF

PLANT, MACHINERY, AND PROCESSES OF MANUFACTURE,

Refining of Bullion, Cost of Working, &c.

Uniform with Part I.—LEAD.

ENGINEERING, DRAWING, AND DESIGN.

By S. H. WELLS, Wh.Sc., A.M.I.C.E., A.M.I.Mech.E. In Two Parts. Sold Separately. Third Edition. I.—Practical Geometry; Plain and Solid. 3s. II.—Machine and Engine Drawing and Design. 4s. 6d.

"Thoroughly useful, exceedingly well written."—*Nature*.

Full Catalogue Post Free on Application.

London: CHARLES GRIFFIN & CO., LTD.,
Exeter Street, Strand.

L. CASELLA,

Scientific Instrument Maker,
Engineer, &c.



THEODOLITES.

LEVELS.

SEXTANTS.

HORIZONS.

COMPASSES.

TELEMETERS.

TIDE GAUGES.

STEAM AND PRESSURE

GAUGES.

ANEROIDS.

&c., &c.

PARTICULARS AND PRICES MAY BE
HAD ON APPLICATION.

WRITE FOR DESCRIPTIVE PAMPHLETS AND CATALOGUES
OF SURVEYING INSTRUMENTS, &c.

147 Holborn Bars,
LONDON, E.C.

Telegraphic Address:—"ESCUTCHEON, LONDON."
Telephone:—No. 1054, HOLBORN.

"NIVOC" SPECIALITIES.

WORKS—BIRMINGHAM.

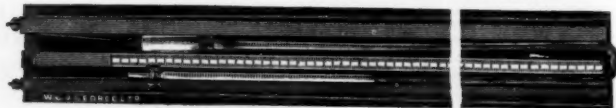
Buy direct from the Manufacturers.

**DIAL RESISTANCE BOX, 20/-.**

Reads from '1 ohm to 99.9 ohms, or from
1 ohm to 999 ohms as desired.

SCHOOL WORLD (Dec. '99) says:—"Messrs. W. and J. George, Ltd., have a large number of novelties with which the teacher of practical physics should make himself acquainted."

COMPLETE LABORATORY FURNISHERS AND MANUFACTURERS
OF CHEMICAL, PHYSICAL AND BACTERIOLOGICAL APPARATUS,
INCLUDING THE CELEBRATED "NIVOC" SPECIALITIES.

**RINTOUL'S SPRING DYNAMOMETER, 2/6.****BOYLE'S LAW APPARATUS, 45/-.**

CATALOGUES ON APPLICATION

W. & J. GEORGE, LTD., 33-37 HATTON WALL, LONDON.
(Late F. E. BECKER & CO.)

MARCH 8, 1900]

NATURE

ccvii

ISENTHAL, POTZLER & CO.,

85 MORTIMER STREET, LONDON, W.

CENTRAL DEPOT FOR RADIOGRAPHERS.

Telegrams :
"HYSTERESIS."



Telephone :
2099, GERRARD.

THE "PUNKTOGRAPH."

WRITE FOR LISTS, OR BETTER INSPECT OUR INSTALLATIONS.
HIGHEST REFERENCES. EVERYTHING NOVEL AND ORIGINAL.

SOLE AGENTS FOR SCOTLAND :

Messrs. JAMES WHITE, Cambridge Street, Glasgow.

THE CAMBRIDGE

SCIENTIFIC INSTRUMENT CO.

Ltd., CAMBRIDGE.

NEW ROCKING MICROTOME.

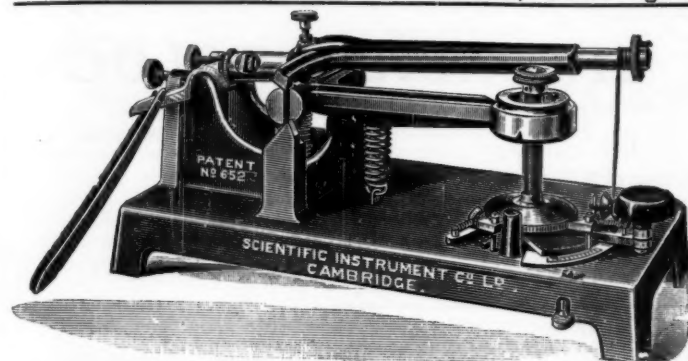
1900 PATTERN. [PATENTED.]

This Instrument possesses the following great improvements over the old type of instruments :—
(1) Increased rigidity. (2) The impossibility of cutting thin and thick sections. (3) The impossibility of tearing sections on the upward movement of the object. (4) A graduated arc for showing the thickness of the sections. (5) Catch for holding the object above the edge of the razor. (6) Improved method of fixing the cord. (7) A new object holder.

PRICE (including object holder), £5 0 0

Write for Pamphlet descriptive of the above Instrument.

Address all communications :—
INSTRUMENT COMPANY, CAMBRIDGE.



NEW SCIENCE LANTERN.

SOLE MAKERS:
REYNOLDS & BRANSON,
Ltd.

IMPROVED
PORTABLE
DESIGN.



The Universal Science Lantern has been devised for the projection of experiments. In the short box in front of the lantern is a hinged mirror, so placed that by the movement of a stud it may be introduced and placed at an angle of 45 degrees with the parallel beam. The beam is thus sent upwards through a horizontal convergent lens, on which a slide or horizontal piece of apparatus can be placed. Above this is the objective mounted on a brass pillar, and above the objective a prism or mirror (if the screen is elevated above the lantern plain prisms are required for each beam), silvered on the outside so that there is no double reflection. The mirror can be adjusted to any angle, and is intended to send the image in an approximately horizontal direction to the screen. Slides can also be directly projected in the usual way.

The base-board is made to fold so that the lantern can be packed into a box 18½ x 8½ x 20½ with all its accessories *in situ*.

Price Complete, in Travelling Box, £9 0 0
REYNOLDS & BRANSON, LTD.
14 COMMERCIAL STREET, LEEDS.

A USEFUL COMPANION FOR THE SCIENTIFIC MAN.

Can be conveniently carried in the pocket, and, therefore, always handy for making notes.

Writes the moment it touches the paper.

Can be used in any position.

Has:—
A Nib of
14-carat Gold.

A Holder of the
Finest Vulcanised
Rubber.

A Perfect Feed, which
ensures absolute regu-
larity of working.

Made in various styles, and with Nibs to
suit all hands.

"E" PRICE LIST SENT POST FREE.

The YÖST TYPEWRITER Co., Ltd.,
50 HOLBORN VIADUCT, LONDON, E.C.

WEST END DEPÔT :—303 Oxford Street.



MACMILLAN & CO.'S NEW SCIENTIFIC BOOKS.

AN ELEMENTARY COURSE OF PRACTICAL ZOOLOGY.

By the late **T. JEFFERY PARKER**, D.Sc., F.R.S., Professor of Biology in the University of Otago, Dunedin, New Zealand, and **W. NEWTON PARKER**, Ph.D., Professor of Zoology at the University College of South Wales and Monmouthshire, in the University of Wales. With 156 Illustrations. Crown 8vo. 10s. 6d.

A MANUAL OF ZOOLOGY.

By the late Prof. **T. J. PARKER**, D.Sc., F.R.S., and Prof. **W. A. HASWELL**, M.A., D.Sc., F.R.S.

With Three Hundred Illustrations. Crown 8vo, 10s. 6d.

KNOWLEDGE.—"The text is accompanied by about three hundred beautiful illustrations. . . . The treatment is explicit throughout, and the book is sure to gain a wide popularity."

TEXT-BOOK OF PALÆONTOLOGY.

By **KARL A. VON ZITTEL**,

Professor of Geology and Palæontology in the University of Munich. Translated and Edited by **CHAS. R. EASTMAN**, Ph.D., Assistant in Palæontology in the Museum of Comparative Zoology at Harvard. With 1476 Woodcuts. Medium 8vo. 25s. net.

*. * This English Edition is revised and enlarged by the Author and Editor in collaboration with numerous Specialists.

SPEAKER.—"In this sphere Prof. Zittel's books have long held the field as the standard works of their class, but to many they have been inaccessible on account of their being in a foreign tongue. . . . It has not merely been translated; it has been edited and brought up to date as well. . . . The author and editor have conferred a great boon upon their fellow-workers, whether English or foreign, by bringing out what is really a new edition of this work. . . . A most valuable addition to the scientific literature of the world, and the publication of the second volume, dealing with the Vertebrata, will be awaited with the keenest interest on all sides."

SIXTH EDITION, LARGELY REVISED, OF PART IV.

A TEXT-BOOK OF PHYSIOLOGY. By Sir **MICHAEL FOSTER**, K.C.B., M.A., M.D., LL.D., F.R.S. Professor of Physiology in the University of Cambridge. Assisted by **W. H. RIVERS**, M.A., M.D., University Lecturer in Physiological and Experimental Psychology in the University of Cambridge. Illustrated. Part IV. **THE SENSES.** 8vo. 10s. 6d.

THE VOICE: Its Physiology and Cultivation. By **WILLIAM A. AIKIN**, M.D. Brux., L.R.C.P. Lond. Crown 8vo. 3s. 6d.

A HISTORY OF MODERN PHILOSOPHY: a Sketch of the History of Philosophy from the Close of the Renaissance to our own Day. By Dr. **HARALD HOFFDING**. Translated from the German by **B. E. MEYER**. In 2 Vols., 8vo, 15s. net each Volume.

OUTLOOK.—"The student could wish for no juster or more dependable *vade mecum*."

VOL. III. (COMPLETING THE WORK) NOW READY.

DICTIONARY OF POLITICAL ECONOMY. Edited by **R. H. INGLIS PALGRAVE**. Vol. III. (completing the work). Medium 8vo, 21s. net. Also ready, Vols. I and II., 21s. net each.

STANDARD.—"Marks the conclusion of a financial work of more than ordinary importance. . . . The information has been well brought up to date. . . . Equally valuable to the student of finance or political economy and to the business community."

THE PRINCIPLES OF MECHANICS PRESENTED IN A NEW FORM.

By **HEINRICH HERTZ**, late Professor of Physics in the University of Bonn. With an Introduction by **H. VON HELMHOLTZ**. Authorised English Translation by **D. E. JONES**, B.Sc., District Inspector under the Department of Science and Art, &c., and **J. T. WALLEY**, M.A. 8vo. 10s. net.

ENGINEER.—"A very remarkable book. . . . A book which it is impossible to pass over in silence, fraught as it is with infinite possibilities of the future. It represents the latest work of one of the finest intellects of the century."

INTRODUCTION TO PHYSICAL CHEMISTRY. By **JAMES WALKER**, D.Sc., Ph.D., Professor of Chemistry in University College, Dundee. 8vo. 10s. net.

LANCET.—"The book is written in such a lucid way as to render its perusal free from that irksomeness which is so often the student's experience when confronted with theoretical considerations. The book should serve as an admirable introduction to more advanced works."

ELEMENTARY CHEMISTRY FOR HIGH SCHOOLS AND ACADEMIES.

By **ALBERT L. AREY**, C.E., Rochester (N.Y.) High School. Crown 8vo. 4s. net.

THE NATURE AND WORK OF PLANTS. An Introduction to the Study of Botany. By **DANIEL TREMBLY MACDOUGAL**, Ph.D., Director of the Laboratories, New York Botanical Garden. Crown 8vo. 4s. 6d.

MACMILLAN AND CO., LIMITED, LONDON.

CO-OPERATIVE WORLD TRAVEL

Organised by HENRY S. LUNN, M.D., F.R.G.S.,
W. HOLDSWORTH LUNN & CONNOP F.S. PEROWNE.

A Cruise to the CENTRAL MEDITERRANEAN.

MARSEILLES, PALMA, ALGIERS, MALTA, SICILY, SALERNO
AND CAPRI, NAPLES, MARSEILLES.)

(Return Ticket to MARSEILLES included.)

AN EIGHTEEN DAYS' CRUISE FOR £21 OS. AND UPWARDS.

S.V. ARGONAUT. Tonnage, 3254; h.-p., 4000.

£10 10s. and £13 13s. TOURS TO ROME.

Extensions to NAPLES, FLORENCE, VENICE,
and the ITALIAN LAKES.

Full particulars from the Secretary, 5 Endsleigh Gardens,
Euston, London, N.W.

PHŒNIX FIRE OFFICE,

9 LOMBARD ST., E.C., and 57 CHARING CROSS, S.W.

ESTABLISHED 1782.

MODERATE RATES. ABSOLUTE SECURITY.

ELECTRIC LIGHTING RULES SUPPLIED.

LIBERAL LOSS SETTLEMENTS.

PROMPT PAYMENT OF CLAIMS.

FRANCIS B. MACDONALD, SECRETARY.

LOSSES PAID OVER £22,000,000.

ESTABLISHED 1851.

BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

INVESTED FUNDS

£10,000,000.

The BIRKBECK ALMANACK, with full particulars, post free.

FRANCIS RAVENSCROFT, Manager.

MINERALS AND PRECIOUS STONES.

Mr. HENSON has now on hand a Fine Series of interesting Sapphires,
also Topazes, Gold, and Barytes in Large Crystals of various Colours.
Large and perfectly clear Rock Crystal Balls, precious Opal Cameos,
Fluor Spar, Agate, Jasper, and other Stones cut for ornamental purposes.

LESSONS GIVEN.

SAMUEL HENSON,

97 REGENT STREET, LONDON, W.

ESTABLISHED 1840.

LIVING SPECIMENS FOR THE MICROSCOPE.

Vulvox, Spirogyra, Desmids, Diatoms, Amœba, Arcella, Actinosphærium,
Vorticella, Stentor, Hydra, Floscularia, Stephanoceros, Melicerta, and many
other Specimens of Pond Life. Price 12. per Tube, Post Free. Helio-
gramma, Astacus, Amphioxus, Rana, Anodon, &c., for Dissection purposes.

THOMAS BOLTON,

25 BALSALL HEATH ROAD, BIRMINGHAM.

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM.

THE LABORATORY, PLYMOUTH.

The following animals can always be supplied, either living
or preserved by the best methods:—

Sycon; Clava, Obelia, Sertularia; Actinia, Tealia, Caryophyllia, Alcy-
onium; Hormiphora (preserved); Leptoplana; Lineus, Amphiporus; Nereis,
Aphrodite, Arenicola, Lanice, Terebella; Lepas, Balanus, Gammarus,
Ligia, Mysis, Nebalia, Carcinus; Patella, Buccinum, Elidone, Pectens
Bugula, Crisia, Pedicellina, Holothurina, Asterias, Echinus; Ascidia, Salpa
(preserved), Scyllium, Raja, &c., &c.

For prices and more detailed lists apply to
Biological Laboratory, Plymouth.

THE DIRECTOR.

MINERALS, FOSSILS, ROCKS.

COLLECTIONS OF THIN SLICES FOR PRACTICAL MICRO-
SCOPIC PETROGRAPHICAL STUDY.

(a) Collections of Thin Slices of all important Rock-forming Minerals,
for the Demonstration of the occurrence of the same in the Rocks, arranged
according to F. Zirkel, "Lehrbuch der Petrographie," 2nd ed., Leipzig,
1893. Collection of 114, respectively, 60 Thin Slices.

Price, in elegant Case, £7; respectively, £3 15s.
(b) New Collection of properly mounted Thin Slices of Rock-forming
Minerals, arranged according to H. Rosenbusch, "Microscopic Physio-
graphy of Minerals," 3rd. ed., Stuttgart, 1897.

120 Thin Sections of 67 different Minerals in elegant Case £9 0 0

50 " " " 34 " " " 3 10 0

(c) Collections of Thin Slices of Rocks, to which will be added a short
printed description of all the Specimens and Slices, arranged according to
H. Rosenbusch, "Microscopic Physiography of Rocks," 3rd. ed., Stutt-
gart, 1896.

Collection of ... 120 180 250 Thin Slices.

Price, in elegant Case, £7 10 0 £11 5 0 £16 5 0

THE NEW CATALOGUE OF MINERALS, METEORITES, &c.,
has just been published, and will be sent, Post free, on application,

Dr. F. KRANTZ,

BONN-ON-THE-RHINE, RHENISH MINERAL OFFICE

ESTABLISHED 1833.

(Represented by Messrs. HARRINGTON BROS., Oliver's Yard,
53A City Road, London, E.C.; and Cork, Ireland.)

WATKINS & DONCASTER,

NATURALISTS,

AND MANUFACTURERS OF

CABINETS AND APPARATUS

FOR ENTOMOLOGY, BIRDS' EGGS, AND ALL BRANCHES OF
NATURAL HISTORY.

SPECIAL SHOW-ROOM FOR CABINETS.

Call or send for detailed Catalogue (66 pp.), Post free on
application.

N.B.—For Excellence and Superiority of Cabinets and
Apparatus, references are permitted to distinguished
patrons, Museums, Colleges, &c.

A LARGE STOCK OF INSECTS AND BIRDS' EGGS.

Birds, Mammals, &c., Preserved and Mounted by First-class Workmen
with true natural surroundings. All Books and Publications on Natural
History supplied.

36 STRAND, LONDON, W.C.

(Five Doors from Charing Cross.)

MINERALS, ROCKS & FOSSILS.

COLLECTIONS FOR STUDENTS.

Carefully labelled and arranged in Boxes with Card Trays.

50 Minerals, 12/6; 100 do., 21/-; 200 do., 42/-.

Rocks and Fossils at similar prices.

300 Minerals in Cabinet, £4 4s.; 400 do., £5 12s. 6d.

Catalogues Post Free.

THOMAS D. RUSSELL,

78 NEWGATE STREET, LONDON, E.C.

PHYSIOGRAPHY and GEOLOGY.

COLLECTIONS & MICROSCOPIC SLIDES,

As advised by Science and Art Directory, arranged by

JAMES R. GREGORY & CO.,
Mineralogists, &c.

To Science and Art Department, British, Indian and Colonial
Museums, &c.

NOVELTIES and RARE GEMS and PRECIOUS
STONES.

Mineral Specimens for Museums, and Collectors, and all purposes.
Rock Specimens and Microscopic Sections of Rocks and Minerals
cut to order.

NEW AND VALUABLE MINERAL SPECIMENS CONSTANTLY
ARRIVING.

Stores & Offices: 1 Kelso Place, KENSINGTON, W.

NEW CATALOGUES AND LISTS FREE.

THE MOST NUTRITIOUS.
E P P S'S
 GRATEFUL—COMFORTING.
C O C O A
 BREAKFAST—SUPPER.

HOLLOWAY'S OINTMENT
 CURES

Gout, Rheumatism, Lumbago, Sciatica, Cuts,
 Bruises, Sprains, &c.

INVALUABLE FOR ALL SKIN DISEASES.

Holloway's Ointment and Pills may be obtained of
 all Medicine Vendors.

T. TAMBLYN-WATTS,
SCIENTIFIC APPARATUS MAKER.

Catalogue of Electrical Apparatus and Materials, 6d. Post free.

Catalogue of Balances and Weights, Apparatus for the Study
 of Mechanics, &c., 6d. Post free.

GOLDIELANDS, SETTLE, YORKS.

BORD'S PIANOS

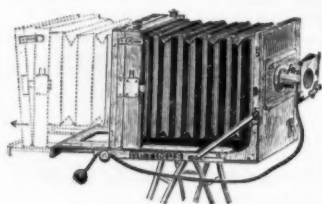
25 per cent. Discount for Cash, or 14/6 per month (second-hand, 10/6 per
 month) on the Three Years' System. Lists free of

C. STILES & CO., 40 & 42 Southampton Row, London, W.C.
PIANOS EXCHANGED.

BECHSTEIN PIANOS

These magnificent Pianos for Hire on the Three Years' System at
 advantageous prices and terms. Lists and particulars free of
CHAS. STILES & CO., 40 & 42 Southampton Row,
LONDON, W.C.

TRADE
 MARK



"OPTIMUS."

**PHOTOGRAPHIC
 APPARATUS**

OF BEST WORKMANSHIP
 FOR ALL PURPOSES.

Catalogue POST FREE.



TELEGRAPHIC
 ADDRESS.

PERKEN, SON & CO., 99, HATTON GARDEN, LONDON.
HOLBORN CIRCUS, E.C.

NOTICE.—Advertisements and business letters for NATURE should be addressed to the Publishers; Editorial
 communications to the Editor. The telegraphic address of NATURE is "PHUSIS," LONDON.

SUBSCRIPTIONS TO "NATURE."

	£	s.	d.
Yearly	1	8	0
Half-yearly	0	14	6
Quarterly	0	7	6
TO ALL PLACES ABROAD:—			
Yearly	1	10	6
Half-yearly	0	15	5
Quarterly	0	8	0

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
*Three Lines in Column	0	2	6
Per Line after	0	0	9
One Eighth Page, or Quarter Column	0	18	6
Quarter Page, or Half a Column	1	15	0
Half a Page, or a Column	3	5	0
Whole Page	6	6	0

* The first line being in heavy type is charged for as Two Lines.

Cheques and Money Orders payable to **MACMILLAN & CO., Limited.**

OFFICE: ST. MARTIN'S STREET, LONDON, W.C.

SECOND-HAND MICROSCOPES

By SWIFT, WATSON, CROUCH, BECK, ZEISS, LEITZ, &c.
 Prices from £2 10s. to £45.

A Large Selection of Second-hand Powers and Fittings for all kinds of
 Microscopes

Send for New List.

CLARKSON & CO., 28 Bartlett's Buildings, Holborn Circus, E.C.

ALBERT EDWARD JAMRACH

(Late CHARLES JAMRACH),

NATURALIST,

180 ST. GEORGE STREET EAST.

Implements of Savage Warfare, Idols, Sacred Masks, Peruvian Pottery,
 Netsukis China, Lacquers, Gongs, Shells, and other Curios.

THE IRISH NATURALIST.

A Monthly Magazine of Irish Zoology, Botany, and
 Geology. Price 6d.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD
 PRAEGER, B.A.

Annual Subscription, 5s. Post Free to any Address.

Dublin: EASON & SON, LTD., 40 Lower Sackville Street
 (to which Address Subscriptions should be sent).

London: SIMPKIN, MARSHALL, HAMILTON, KENT, & CO., Ltd.

NOTICE.—SPECIAL RE-ISSUE BY NATURE
OF THE
INTERNATIONAL SCIENTIFIC SERIES
FOR A STRICTLY LIMITED PERIOD.
EIGHTY-SIX VOLUMES.

A COMPLETE LIBRARY OF SCIENCE AT
A GREATLY REDUCED PRICE.

PUBLISHERS' PRICE	...	...	...	...	£21 10 0
BY INSTALMENT (TO-DAY)	...	...	...	...	£14 14 0
FOR CASH	...	...	...	...	£13 10 0

The "International Scientific Series" has a world-wide reputation, and is to be found in every well-equipped Library throughout the English-speaking world. No more generous or acceptable present could be made to any Public Library or individual than this magnificent Encyclopædia of Scientific Research.

Most of the works are illustrated, and many with beautiful coloured plates. The Series has been contributed to by men of science of the highest eminence, such as Tyndall, Herbert Spencer, Walter Bagehot, Alexander Bain, Stanley Jevons, Huxley, Sir John Lubbock, G. J. Romanes, Balfour Stewart, Sir Norman Lockyer, Draper, Bonney, Sir Hubert Parry, Sir E. Maunde Thompson. This list only professes to convey a slight idea of the attention that has been given to the whole Series by the selection of only the best writers to deal with the various subjects considered.

This special offer is open only for a short time, and intending purchasers will do well therefore to send their orders without delay.

For the benefit of those who do not feel disposed to buy the entire Series, it will be possible to secure half the Series, making 43 volumes, for £7 cash, or £7 7s. on the instalment system, the purchaser himself selecting the volumes. The whole Series or half, as the case may be, will be sent on receipt of the first payment of One Guinea—the rest to be paid at the rate of £1 1s. per month.

NOTE:—OFFER OPEN ONLY FOR A SHORT TIME.
ORDER AT ONCE.

A Set of the Volumes may be seen at the Office of NATURE, ST. MARTIN'S STREET, W.C.

A Pamphlet, giving titles, &c., of the Works in the Series, Specimen Pages, with Illustrations, of some of the Volumes, also Order Form, will be sent Post Free on application to

C. WORSFOLD, "NATURE" Office, St. Martin's Street, London, W.C.

ORDER FORM.

Date.....1900.

All cheques should be crossed and made payable to C. WORSFOLD, "NATURE" Office, St. Martin's Street, W.C.

I enclose One Guinea as first payment for "NATURE's Re-issue of the International Scientific Series," and I agree to pay to you, or your representative, the balance at the rate of One Guinea per month; my next payment to be on delivery of the volumes, and my remaining payments on the corresponding day of each month following.

Until such payments are complete, I engage that the Works, not being my property, shall not be disposed of by sale or otherwise.

I further agree that if it be found impossible for any reason to deliver the books, the return of the sum of One Guinea to me shall cancel this agreement.

Name.....

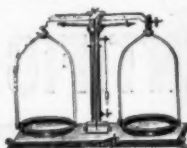
Address.....

Residents abroad are kindly requested to remit in full, or to instruct their representatives in England to make the monthly payments, in order to avoid the expense and delay in forwarding cash from abroad.



HARRIS'S ORIGINAL PATTERN ATWOOD MACHINE, 1012A, Accurate and Reliable, 8 to 9 feet high, Graduated, £3 15s.

HARRIS'S SPECIALITIES.—CATALOGUES UPON APPLICATION.



Reliable Balances, 1059A. 100 grm. to 1 mgm. Agate Planes and Knife Edges, £1 9s. 6d.; Steel, £1 4s.



Resistance Box, Post Office, £6 10s. 4775A.



New Mechanical Apparatus. See List.



Stroud and Rendell Lantern, £9. 6s. 9d.

PHILIP HARRIS & Co. LTD.,

Telegraphic Address: "Science," Birmingham. Telephone No. 10.

COMPLETE LABORATORY FURNISHERS, BIRMINGHAM.

WATSON'S NEW MICROSCOPES AND APPARATUS.



WATSON'S HOLOSCOPIC EYEPIECES, for use with either APOCHROMATIC or ACHROMATIC OBJECTIVES, an adjustment being provided to the special lenses employed, for altering the correction. There is no sacrifice of efficiency, the performance being equal to the most expensive Compensating or Huyghenian Oculars.

Magnifying Powers—

6 in. tube length, 5, 7, 10, and 14 diameters.
10 in. " 7, 10, 14, and 20 "

PRICE, in Student's Size and Pattern, either power, 17/6 each.

For Full Particulars see Supplemental List, Post Free.

WATSON'S Parachromatic OIL IMMERSION CONDENSER.

Total aperture, 1.30; applanatic aperture exceeds 1.25. Undoubtedly the finest Condenser obtainable for high-power work. Optical part only ... £5 0 0

Completely mounted with Iris Diaphragm and Set of Stops ... £8 10 0

WATSON'S "SCHOOL" MICROSCOPE, New Model, complete with 1 in. Objective, in Case ... £3 3 0

WATSON'S "ROYAL" MICROSCOPE. A new model high-class instrument.

WATSON'S "FRAM" MICROSCOPE. A highest-class instrument at a very moderate cost.

BACTERIOLOGICAL APPARATUS. MICROTOMES. Apparatus for FIELD BOTANY and FIELD GEOLOGY. METAMORPHOSES and DISSECTED PREPARATIONS. BOTANICAL and PHYSIOLOGICAL MODELS.

For Particulars of all the above, see

Watson's New Supplemental List to Catalogue No. 2, Post Free on application.

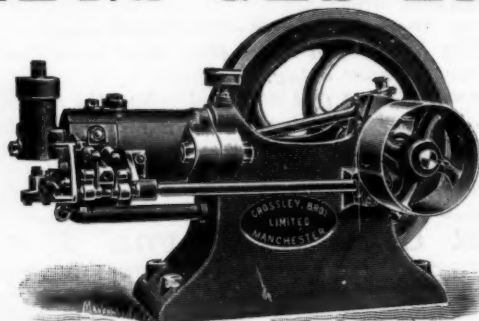
Watson's Catalogue (No. 3) is a Classified List representing a Stock of 40,000 first-class Micro-Slides, Post free on application.

W. WATSON & SONS (Established 1837), Opticians to H.M. Government.

373 HIGH HOLBORN, LONDON, W.C. New Branch Now Open: 16 FORREST ROAD, EDINBURGH. And at 78 Swanston Street, Melbourne, Australia. Awarded 39 Gold and other Medals at the principal International Exhibitions of the World.

CROSSLEY'S GAS ENGINES.

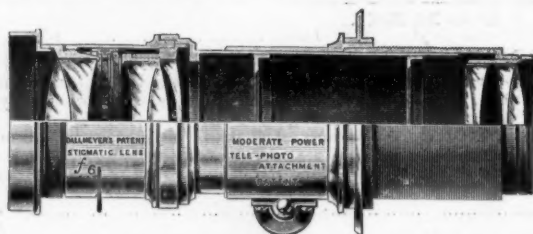
RECENTLY
REMODELLED.



GREAT
REDUCTION
IN
GAS
CONSUMED.

CROSSLEY BROS., LTD., OPENSHAW, MANCHESTER.

DALLMEYER'S TELE-PHOTO. LENSES & ATTACHMENTS



Enable you to take Photographs of Distant or Inaccessible Subjects of sufficient size to be of practical value. Indispensable to Geologists, Naturalists, and Architects.

Price from £3 15s.

Prices and Particulars on application. Estimates and advice free.

Stigmatic Lens fitted with Tele-Photo. Attachment. (These Attachments can be fitted to any good Lens.)

J. H. DALLMEYER, Ltd.,
25 Newman Street, London, W.

Printed by RICHARD CLAY AND SONS, LIMITED, at 7 & 8 Bread Street Hill, Queen Victoria Street, in the City of London and published by MACMILLAN AND CO. LIMITED, at St. Martin's Street, London, W.C., and THE MACMILLAN COMPANY, 66 Fifth Avenue, New York.—THURSDAY, March 8, 1900.



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

No. 1585, VOL. 61]

THURSDAY, MARCH 15, 1900.

[PRICE SIXPENCE.

Registered as a Newspaper at the General Post Office.]

[All Rights are Reserved

WIRELESS TELEGRAPHY.

The "APPS-NEWTON" INDUCTION COILS have proved far superior to all others in telegraphing long distances without wires.

They were used in the Government Experiments at Penarth and Dover; also by Signor Marconi and the Wireless Telegraph Company in telegraphing to and from the Goodwin Lightship, and across the Channel; at the British Association Meeting at Dover for telegraphing to France; and at the Naval Manœuvres, where a distance of sixty miles was covered, &c.

After prolonged tests the "Apps-Newton" Coils have been adopted by the Wireless Telegraph Company, by the War Office and by the Admiralty; several have been sent to the Front in South Africa, and the ships of the Channel Squadron are now being fitted with them.

PRICES ON APPLICATION.

SOLE MAKERS:

NEWTON & CO.,

Scientific Instrument Makers to H.M. the Queen
and the Government,

3 FLEET STREET, LONDON, E.C.

NEW

DOUBLE-SURFACE CONDENSER

(CRIBB'S PATENT).

Large Condensing Surfaces.

Small size of Condenser. Small weight.

Great Efficiency.

EQUAL TO A LIEBIG CONDENSER FIVE,
TIMES ITS SIZE.

SOLE MAKERS of the Metal Condensers:

JOHN J. GRIFFIN & SONS, L^d,
20-26 SARDINIA STREET, LONDON, W.C.

EARLY CHAPTERS IN SCIENCE.

A FIRST BOOK OF KNOWLEDGE OF NATURAL
HISTORY, BOTANY, PHYSIOLOGY,
PHYSICS AND CHEMISTRY FOR YOUNG PEOPLE.

By Mrs. W. AWDRY

(WIFE OF THE BISHOP OF SOUTH TOKYO, JAPAN).

EDITED BY W. F. BARRETT, F.R.S.,

PROFESSOR OF EXPERIMENTAL PHYSICS IN THE ROYAL
COLLEGE OF SCIENCE FOR IRELAND.

With nearly Two Hundred Illustrations. Crown 8vo, 6s.

"Deserves a warm welcome from all teachers of the young. . . . The illustrations are models of clear, careful, and unconventional work."—*Literature.*

"It can be confidently recommended to the young as a sound and pleasantly written introduction to science."—*Guardian.*

JOHN MURRAY, ALBEMARLE STREET, W.

NEGRETTI & ZAMBRA'S LONG RANGE BINOCULARS AND TELESCOPES FOR MILITARY PURPOSES.

ILLUSTRATED PRICE LISTS FREE BY POST TO
ALL PARTS OF THE WORLD.

SPECIAL TERMS TO YEOMANRY TROOPS AND VOLUNTEER
CORPS REQUIRING SEVERAL GLASSES.



THE "READY-FOCUS" BINOCULAR.

A great
improvement over the ordinary system
of Focussing.
Invaluable in watching moving
objects.

NEGRETTE & ZAMBRA,

SCIENTIFIC INSTRUMENT MAKERS TO THE QUEEN,
38 HOLBORN VIADUCT, E.C.

BRANCHES: 45 CORNHILL; 122 REGENT STREET.

ROYAL INSTITUTION OF GREAT BRITAIN,

ALBEMARLE STREET, PICCADILLY, W.

HALFORD JOHN MACKINDER, Esq., M.A., Reader in Geography in the University of Oxford, will on Thursday next, March 22, at Three o'clock, begin a Course of Three Lectures on "Equatorial East Africa and Mount Kenya." (Illustrated by Lantern Slides.)
Half-a-Guinea the Course.

Mr. Sidney Lee will deliver a Lecture on

"Shakespeare and the Elizabethan Playgoer," in the Pfeiffer Hall at Queen's College, 43 and 45 Harley Street, W., on Tuesday, March 20th, at 5 p.m.

For tickets (price half-a-crown), apply to the LADY RESIDENT.

TECHNOLOGICAL EXAMINATIONS, 1900. CITY AND GUILDS OF LONDON INSTITUTE.

The Institute's EXAMINATIONS in TECHNOLOGY will be held on April 30; May 1, 2, 3, 5, 7, 8, 11, 12, 19 and 29.

All applications from Local Secretaries for Examination in Technology must be forwarded to the Institute on or before March 26.

Only in exceptional cases, and by payment of an additional fee, can application be received from Local Secretaries after that date.

Candidates in Technology not attending any registered class should apply at once to the Secretary at the nearest local centre.

Applications from any individual Candidates for Examination at the Offices of the Institute should be made not later than April 3, and should state clearly the subject and grade of examination. Applications should be addressed to the Examinations Department, City and Guilds of London Institute, Exhibition Road, London, S.W., and should be accompanied by a postal order for the amount of the fee.

UNIVERSITY OF ABERDEEN.

FACULTY OF MEDICINE.

SUMMER SESSION, 1900.

The Summer Session commences on Tuesday, April 24.

The Preliminary Examination will commence on March 24.

The Degrees in Medicine granted by the University are:—Bachelor of Medicine (M.B.), Bachelor of Surgery (Ch.B.), Doctor of Medicine (M.D.), and Master of Surgery (Ch.M.). The total cost of the whole curriculum, including fees for the Degrees of M.B. and Ch.B., is usually about £125.

A Prospectus of the Classes, fees, &c., together with Regulations for the Preliminary Examination and for Graduation in Medicine and Surgery, may be had free on application to the Secretary of the Medical Faculty. The University also grants Degrees in Arts, Science, Law, and Divinity, particulars of which may be had on application to the SECRETARY OF FACULTY.

UNIVERSITY COLLEGE, LONDON.

FACULTY OF MEDICINE.

The Summer Session begins on May 1st. The work is arranged so that a Student may advantageously begin his Medical Curriculum then.

Full information may be obtained from either of the undersigned.

H. R. SPENCER, M.D., F.R.C.P.,

Dean of the Faculty.

J. M. HORSBURGH, M.A., Secretary.

SCIENCE AND ART EXAMS.

LONDON AND SOUTH KENSINGTON.

Oral or Correspondence Preparation by SPECIALIST TUTORS.

New and Perfected System of Correspondence Tuition. WORKSHEETS A SPECIALITY, saving Time and Trouble.

ADDRESS:—

JOHN GIBSON, M.A., 24 CHANCERY LANE, W.C.

SCIENCE EXAMINATIONS.

For LONDON and other UNIVERSITIES, the
CONJOINT BOARD, &c.

Well-equipped LABORATORIES, DAY AND EVENING. Personal or Class Tuition.

"R," 9 Heathcote Street, Gray's Inn Road, W.C.

WANTED, for the National Physical

Laboratory, a LABORATORY ASSISTANT and MECHANIC. Applicants should have had experience both in an Instrument Maker's Shop and in a Laboratory. Some knowledge of Glass-blowing and Pattern making is also desirable. Applications, stating age, qualifications and salary required, and giving references, should be made by letter addressed to the DIRECTOR, National Physical Laboratory, Old Deer Park, Richmond.

Sales by Auction.

Valuable Scientific and Miscellaneous Books, including the Library of the late W. HARKNESS, Esq., F.I.C., F.C.S., and other properties.

Messrs. HODGSON will Sell by Auction,

at their Rooms, 115 Chancery Lane, W.C., on Wednesday, March 22, and two following days, VALUABLE SCIENTIFIC BOOKS, including the above Library, and comprising a Complete Set of the *Challenger* Reports, in 50 Vols.; *Journal of Chemical Industry*, 1882 to 1899; *Chemical Society's Journal*, 1876 to 1899; Quarterly and Monthly Microscopical Journals, 1853 to 1877; *Microscopical Society's Journal*, 1878 to 1899, in 33 Vols.; Schmidt's *Diatomaceen-Kunde*, 4 Vols., and other English and Foreign Works on the Diatomaceae; by Van Heurck and others; Cooke's *British Desmids*; *Bentham's British Flora*, 2 Vols.; Sedgwick and McCoy's *Paleozoic Rocks*; New Sydenham Society's Publications; and other Scientific and Miscellaneous Books.

To be viewed, and Catalogues had.

TUESDAY AND WEDNESDAY, MARCH 27 AND 28.
THE "SAMUEL STEVENS" COLLECTION.

MR. J. C. STEVENS begs to announce that

he has received instructions from the Executors to Sell by Auction, at his Great Rooms, 38 King Street, Covent Garden, on Tuesday and Wednesday, March 27 and 28, the well-known Collection of British Lepidoptera, formed by the late SAMUEL STEVENS, Esq., the result of over sixty years' collecting and breeding; consisting probably of over 100,000 specimens, and amongst them some wonderful and exceptional varieties of a very large number of species, and a long series of many rare and extinct species too numerous to mention.

On view day prior, to till 4. Catalogue in preparation, and can be had on application.

FOR SALE BY ORDER OF THE EXORS.

The unique MICROSCOPIC SPECIMENS

COLLECTED BY THE LATE

MR. H. VIRTUE TEBBS.

Selections can be made at

C. BAKER'S, 244 HIGH HOLBORN, LONDON,
Telegrams—Optivorum, London. Telephone—1427, Holborn.

THE SCIENTIFIC ROLL AND MAGAZINE OF SYSTEMATIZED NOTES.

THIS WORK IS A VALUABLE
GUIDE, BIBLIOGRAPHY, AND INDEX TO SCIENCE.

In preparation.

BACTERIA (Botanical Section).

Although these are the simplest of plants, there is probably no group of organisms which exceeds them in interest or importance. Their operations affect the *welfare of every member of the community*, as also of the whole organic world. A full knowledge of them is essential in all questions bearing upon public and private health, agriculture, the microbial diseases of animals and of plants; and it is important in many industries, such as those dealing with milk, butter, hay, flax, tobacco, and others.

The group will be dealt with in three octavo volumes of about 500 pp. each. The subscription price will be 10s. for each volume, payable on delivery of the first number of the volume; or arrangements may be made to supply only the portions relating to a particular species, genus, or topic, at a proportionately reduced rate. The first volume will be commenced next summer, and if sufficient subscribers support the work, the three volumes will be completed in three years. As all the matter will be systematized, the series will be equivalent to a good bacteriological library, with the advantage that the information on any particular point will be comprised within a comparatively few pages, and not scattered over thousands of pages in a host of journals and books.

The names and addresses of subscribers, and applications for prospectus may be sent to the undersigned.

The undersigned will be glad to hear from PRINTERS willing to give estimates for printing, and from PUBLISHERS willing to consider terms for publishing the above-mentioned work.

A. RAMSAY,
4 Cowper Road, Acton, London, W.

Next Week, the Third Edition, Revised and Enlarged, with 68 Engravings, Post 8vo, 3s. 6d.

PROFESSORS CLOWES and COLEMAN'S ELEMENTARY PRACTICAL CHEMISTRY.

London: J. & A. CHURCHILL, 7 Great Marlborough Street.

BARGAINS IN SCIENTIFIC BOOKS.

CAMPBELL (D. H.), THE STRUCTURE

AND DEVELOPMENT OF THE MOSSES AND FERNS (ARCHGONIATÆ). By DOUGLAS HOUGHTON CAMPBELL, Ph.D. Fully Illustrated. Medium 8vo. (Pub. 14s. net.) 4s.
 "Dr. Campbell's book is clearly written, well illustrated, is provided with an accurate bibliography and a copious index, so that it will take its place at once as a standard classic, and will, we think, retain that position for no inconsiderable period."—*Gardener's Chronicle*.

BATESON (W.), MATERIAL FOR THE

STUDY OF VARIATION, treated with especial regard to Discontinuity in the Origin of Species. By WILLIAM BATESON, M.A., Fellow of St. John's College, Cambridge. 8vo, Cloth. (Pub. 21s. net.) 5s.

"The whole work must be carefully read by every serious student; and there can be no question of its great and permanent value as a contribution to our knowledge of a particular class of variations, and as a stimulus to further work in a department of knowledge which is too much neglected."—*Nature*.

HEADLEY (F. W.), THE STRUCTURE

AND LIFE OF BIRDS. By F. W. HEADLEY, M.A., F.Z.S., Assistant Master in Haileybury College. With 78 Illustrations. Crown 8vo, Cloth. (Pub. 7s. 6d.) 1s. 9d.

"We know of no book, at any rate, no modern book, which covers precisely the ground of Mr. Headley's Manual; it strengthens decidedly a weak point in Ornithological literature, and this fact, coupled with the excellence of the illustrations, should ensure for it a wide circulation."—*Ibis*.

COUES (Prof. ELLIOTT), HANDBOOK

OF FIELD AND GENERAL ORNITHOLOGY, a Manual of the Structure and Classification of Birds, with Instructions for Collecting and Preserving Specimens. Illustrated. Demy 8vo, Cloth. (Pub. 10s.) 2s. 6d.

The volume consists of two distinct parts:—PART I.—Field Ornithology contains the necessary Instructions for the Observation and Collection of Birds in the field, and for the Preparation and Preservation of Specimens for scientific study in the Cabinet. PART II.—General Ornithology is a technical Treatise of the Classification, the Zoological Characters, and the Anatomical Structure. CHAPTERS.—Implements for Collecting and their Use—Dogs—Suggestions and Directions for Field-work—Hygiene of Collectors—Registration and Labelling—Instruments—Materials and Fixtures—How to make a Bird-skin—Collection of Nests and Eggs—Care of a Collection—Definition of Birds—Principles and Practice of Classification—Definitions and Descriptions of the Exterior Parts of Birds—An Introduction to the Anatomy of Birds.

Postage 4d. extra on one, or 6d. on four.

H. J. GLAISHER, New and Remainder Bookseller, 57 Wigmore Street, London, W.

Catalogues Post Free on application.

LABORATORY NOTE-BOOK FOR CHEMICAL STUDENTS.

By VIVIAN B. LEWES,

PROFESSOR OF CHEMISTRY, ROYAL NAVAL COLLEGE, AND

J. S. S. BRAME,

ASSISTANT EXAMINER IN CHEMISTRY, SCIENCE AND ART DEPARTMENT.

Interleaved throughout with Writing Paper.

Price 4s.

"... the book is well calculated to lead the student to dependence on his own resources—that is, after all, the aim of knowledge."—*Industries and Iron*.

"A good course of experimental work in chemistry suitable for technical and other students... the volume is an advance on most similar laboratory manuals."—*Nature*.

ARCHIBALD CONSTABLE & CO., 2 Whitehall Gardens, Westminster.

Now Ready, 8vo, Price 6s. net.

RECENT & COMING ECLIPSES.

By

SIR NORMAN LOCKYER, K.C.B., F.R.S.,

Second Edition, containing an account of the observations made at Viznadrug, in India, in 1898, and of the conditions of the Eclipses visible in 1900, 1901 and 1905.

MACMILLAN AND CO., LTD., LONDON.

BOOKS ON EGYPT AND CHALDÆA.

FOUR VOLUMES NOW READY.

By Dr. E. A. WALLIS BUDGE, M.A. EGYPTIAN IDEAS OF A FUTURE LIFE.

With 8 Illustrations. Crown 8vo. 3s. 6d. net.

EGYPTIAN MAGIC.

With 20 Illustrations. Crown 8vo. 3s. 6d. net.

EASY LESSONS IN HIEROGLYPHICS, WITH SIGN LIST.

Crown 8vo. 3s. 6d. net.

By L. W. KING, M.A., F.S.A. BABYLONIAN RELIGION AND MYTHOLOGY.

With 12 Illustrations. Crown 8vo. 3s. 6d. net.

"A most desirable series."—*Knowledge*.

"Mr. King has done his work excellently well, and his book forms a good introduction to the study of Babylonian religion."—*Academy*.

"In aiding to popularise Egyptian lore, Dr. Budge is rendering a genuine service. His books may be warmly commended to all whom the study of Egyptology attracts."—*Notes and Queries*.

"It is impossible to do fitting justice to the contents of these most interesting volumes, and the care with which the great mass of facts which they contain has been condensed defies any attempt to reduce them to a précis. . . . There will be few who will not learn from these volumes much detail of which they were previously ignorant, and may well derive from them their first clear conception of what was really believed to ancient Babylonia, and of the sublime grandeur of that faith which during so many centuries was the spiritual stay and solace of the Egyptians."—*Nature*.

"The series will form an excellent introduction to Egyptology."—*Western Morning News*.

"'Egyptian Magic' is excitingly interesting to all students of psychical subjects."—*Light*.

"'Babylonian Religion' forms a handy companion for those who require a knowledge of the religion of the ancient Babylonians."—*Glasgow Herald*.

LONDON:

KEGAN PAUL, TRENCH, TRÜBNER & CO., LTD.,
CHARING CROSS ROAD, W.C.

CO-OPERATIVE WORLD TRAVEL

Organised by HENRY S. LUNN, M.D., F.R.G.S.,
W. HOLDSWORTH LUNN & CONNOP F.S. PEROWNE.

A Cruise to the CENTRAL MEDITERRANEAN.

(MARSEILLES, PALMA, ALGIERS, MALTA, SICILY, CAPRI,
NAPLES, MARSEILLES)

(Return Ticket to MARSEILLES included.)

AN EIGHTEEN DAYS' CRUISE FOR £21 OS. AND UPWARDS.

s.v. ARGONAUT. Tonnage, 3254; h.-p., 4000.

£10 10s. and £13 13s. TOURS TO ROME.

Extensions to NAPLES, FLORENCE, VENICE,
and the ITALIAN LAKES.

Full particulars from the Secretary, 5 Endsleigh Gardens,
Euston, London, N.W.

LETCHER & SONS (formerly Letcher Bros.),

SCIENTIFIC INSTRUMENT MAKERS,

25 TURNPIKE LANE, HORNSEY, N.

BLOWPIPE CABINETS. SPECIALITY: SOCIETY OF ARTS SETS.



GLASS BLOWING

GEISSLER TUBES IN BEAUTIFUL DESIGNS.

TUBES containing specimens of Fluorescent and Phosphorescent
Minerals, Salts, Rubies, &c.

ILLUSTRATED TUBE contains Vanes which Fluoresce in three
brilliant colours, and revolve by means of Cathode Rays.

COSSOR, 67 FARRINGTON ROAD, E.C.

TO SCIENCE LECTURERS.

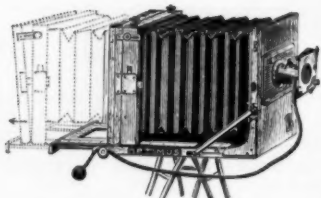
HUGHES' MOTO-PHOTOSCOPE FOR LIVING PICTURES.

THE MOST PERFECT.

No SHUTTER, therefore no Flickering. Superb Mechanism.

The Moto-Photo Camera for taking the Pictures. Illustrated Lists, ad.
See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN,
&c. Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great
success. New Oxyhydrogen Microscope. Science Lanterns for Class
Demonstration. Magnificent Results. Docwra Triple, Prize Medals
Highest Award. Supplied to the Royal Polytechnic Institution, Dr. H. GRAY-
TAN GUINNESS, Madame ADELINA PATTI, &c. Patent Pamphengo
Science Lanterns. The Universal Lantern 4-inch Condensers, 4-wick Lamp,
Portrait Combination front Lenses, 18s. 6d., Marvellous value. Science
Lecture Sets. Novelties. The Lantern Kaleidoscope. Cheapest Lantern
Outfits in the World. Grandly Illustrated Catalogue, over 120 choice En-
gravings, 6d.; Postage, 3d. List of 300 Lecture Sets, Science Subject-
Views, &c., 6d.; Postage 2d. Pamphlets Free. W. C. HUGHES,
SPECIALIST, Brewster House, 82 Mortimer Road, Kingsland, N.

TRADE
MARK



"OPTIMUS."

PHOTOGRAPHIC

APPARATUS

OF BEST WORKMANSHIP

FOR ALL PURPOSES.

Catalogue POST FREE.



TELEGRAPHIC
ADDRESS.

PERKEN, SON & CO., 99, HATTON GARDEN, HOLBORN CIRCUS, E.C. LONDON.

CARL ZEISS, OPTICAL WORKS, JENA. ASTRONOMICAL DEPARTMENT.



Binary Apochromatic Telescope Object-Glasses, free from Secondary
Spectrum, for Visual purposes. Aperture from 1.17 to 1.20.
Triple Photo-Visual Object-Glasses, free from Secondary Spectrum and
Differences in Focus, for Observation and Photography. Aperture 1.10 to
1.15.

Apochromatic Aplanatic Object-Glasses, with reduced Secondary Spec-
trum, for Astro-Photography.

Achromatic Eye-Pieces, with long Eye-Distance.

Telescope Object-Glasses made of ordinary Silicate Glasses.

Objectives, Prisms, Eye-Pieces, and all Astronomical Accessories.

Complete Mounts for Telescopes in any desired form and size.

Special Astronomical Catalogue, in German, French or English,
free on application.

London Branch: 29 Margaret Street, Regent Street, W.

JAS. SWIFT & SON,

MANUFACTURING OPTICIANS.

SOLELY APPOINTED TO THE A.M. DEPT.
WAR OFFICE, FOR THE SUPPLY
OF MICROSCOPES.



Patent form of Student's Microscope,
fitted with 2 1/2" and 1 1/2" Pan-Aplanatic
Objectives, Iris Diaphragm and Oculars,
in Case, from

£5 5s.

These Instruments we have supplied in
numbers to the following Medical Schools,
viz. St. Mary's, St. Bartholomew's, Guy's,
Middlesex, London, and St. Thomas's.

Seven Gold Medals awarded for excel-
lence of manufacture.

Catalogue on Application.

81 TOTTENHAM COURT ROAD, W.

EVERETT & CO., MECHANICAL ENGINEERS AND ELECTRICIANS,

22 CHARTERHOUSE SQUARE, E.C.

Makers of High-Grade Physical and Electrical Apparatus.

Apparatus designed and made for Laboratories and Research Work.

ALL KINDS OF EXPERIMENTAL WORK.

Our List is now ready, and may be had post free
on application.

MESSRS. LONGMANS & CO.'S SCIENTIFIC BOOKS.

JUST PUBLISHED. 8vo, 15s. net.

THE KINETIC THEORY OF GASES.

ELEMENTARY TREATISE, WITH MATHEMATICAL APPENDICES.

By Dr. OSKAR EMIL MEYER,

Professor of Physics at the University of Breslau. Second Revised Edition. Translated by ROBERT E. BAYNES, M.A., Student of Christ Church, Oxford, and Dr. Lee's Reader in Physics.

"Mr. Baynes, in preparing the English version of a new edition of Meyer's treatise, has given English readers a book calculated to meet the wants of a large and varied class of persons interested in the kinetic theory. . . . Now that we have an English edition, students can have no excuse for not carrying their knowledge of the subject rather further, for a better introductory treatise could hardly be written, and there is little in Meyer's treatment that could present difficulties even to the veriest beginner."—*Nature*.

Complete in THREE VOLUMES, Half-Bound. Vol. I., with 236 Illustrations, 8vo, £2 2s. Vol. II., with 240 Illustrations, 8vo, £2 2s. Vol. III., with 352 Illustrations, 8vo, £3 3s.

A DICTIONARY OF APPLIED CHEMISTRY.

By T. E. THORPE, B.Sc. (Vict.), Ph.D., D.Sc. (Dubl.), F.R.S.,

Professor of Chemistry in the Royal College of Science, London. Assisted by Eminent Contributors.

THE PRINCIPLES OF CHEMISTRY. By D. MENDELÉEFF. Translated from the Russian (Sixth Edition) by GEORGE KAMENSKY, A.R.S.M. of the Imperial Mint, St. Petersburg; and Edited by T. A. LAWSON, B.Sc., Ph.D., Fellow of the Institute of Chemistry. With 96 Diagrams and Illustrations. 2 Vols., 8vo, 36s.

A TEXT-BOOK OF INORGANIC CHEMISTRY. By G. S. NEWTH, F.I.C., F.C.S., Demonstrator in the Royal College of Science, London; Assistant Examiner in Chemistry, Science and Art Department. Fifth Edition. With 146 Illustrations. Crown 8vo, 6s. 6d.

CHEMICAL ANALYSIS, QUANTITATIVE AND QUALITATIVE. By G. S. NEWTH, F.I.C., F.C.S., Demonstrator in the Royal College of Science, London; Assistant Examiner in Chemistry, Science and Art Department. With 100 Illustrations. Crown 8vo, 6s. 6d.

A TEXT-BOOK OF PHYSICS. By W. WATSON, B.Sc., Assistant Professor in Physics in the Royal College of Science, London; Assistant Examiner in Physics, Science and Art Department. For use in Technical Schools, Advanced Science and Art Classes, Engineering Schools, Universities, &c., &c. With 564 Illustrations. Large Crown 8vo, 10s. 6d. *[Just published.]*

ELECTRICAL ENGINEERING. For Electric Light Artisans and Students. (Embracing those branches prescribed in the Syllabus issued by the City and Guilds Technical Institute.) By W. SLINGO and A. BROOKER. ENLARGED AND REVISED EDITION. With 359 Illustrations. Crown 8vo, 12s.

THE TESTING OF MATERIALS OF CONSTRUCTION. A Text-book for the Engineering Laboratory and a Collection of the Results of Experiment. By WILLIAM CAWTHORNE UNWIN, F.R.S., M.Inst.C.E., Hon. M.Inst.M.E., Professor of Engineering at the Central Technical College of the City and Guilds of London Institute. SECOND EDITION, REVISED AND ENLARGED. With 5 Plates and 188 Illustrations and Diagrams in the Text. 8vo, 16s. net.

HALF-HOURS WITH THE STARS: a Plain and Easy Guide to the Knowledge of the Constellations. By RICHARD A. PROCTOR. Showing in 12 Maps the position of the principal Star-Groups night after night throughout the year. With Introduction and a separate Explanation of each Map. True for every Year. 4to, 3s. 6d.

RIVINGTON'S COURSE OF BUILDING CONSTRUCTION.

NOTES ON BUILDING CONSTRUCTION. Arranged to meet the Requirements of the Syllabus of the Science and Art Department of the Committee of Council on Education, South Kensington. Medium 8vo.

PART I. ELEMENTARY STAGE. With 552 Illustrations. 10s. 6d.

PART II. ADVANCED STAGE. With 479 Illustrations. 10s. 6d.

PART III. MATERIALS. Course for Honours. With 188 Illustrations. 21s.

PART IV. CALCULATIONS FOR BUILDING STRUCTURES. Course for Honours. With 597 Illustrations. 15s.

LONGMANS, GREEN & CO., LONDON, NEW YORK, AND BOMBAY.

SCOTTISH PROVIDENT INSTITUTION.

HEAD OFFICE: 6 St. Andrew Square, EDINBURGH.

MUTUAL ASSURANCE with MODERATE PREMIUMS.

More than one half of the Members who died during the Septennial period were entitled to Bonuses which, notwithstanding that the premiums do not as a rule exceed the non-profit rates of other Offices, were on the average equal to an Addition of about 50 per cent. to the Policies which participated.

The SURPLUS at last Division was £1,423,000.

Examples of Premium for £100 at Death, with Profits.

AGE.	30*	35	40	45	50	55
DURING LIFE,	£2 1 6	£2 6 10	£2 14 9	£3 5 9	£4 1 7	£5 1 11
25 PAYMENTS,	2 13 0	2 17 9	3 4 6	3 14 0	4 8 7	5 6 11
15 PAYMENTS,	3 12 1	3 18 0	4 5 8	4 16 2	5 11 8	6 9 11

* A person of 30 may secure £1000 at death by a yearly payment during life, of £20 15s., which would in many Offices secure (with profits) £800 only. Or he may secure £1000 by 25 payments of £26 10s., being thus free of payment before age 55.

ACCUMULATED FUNDS, £11,000,000.

Prospectus, with full information, on application.

LONDON OFFICE: 17 KING WILLIAM STREET, E.C.

J. MUIR LEITCH, Secretary.

GAMBRELL BROS., 17 GILTSPUR STREET, LONDON.

Telegrams "GAMBREUM, LONDON."

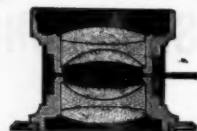
Electricians & Manufacturers

OF
HIGH GRADE ELECTRICAL
AND
PHYSICAL APPARATUS.



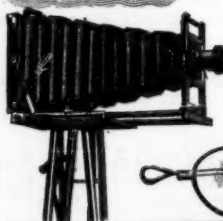
BRIDGE FOR WORKSHOP USE.

WRITE FOR PRICE LIST.



ROSS, Ltd.,

Manufacturers of Celebrated
ROSS' PORTRAIT AND VIEW LENSES
ROSS-ZEISS' ANASTIGMATIC LENSES
ROSS-GOERZ' DOUBLE ANASTIGMATS
ROSS' NEW HAND-CAMERA LENSES
ROSS' FIELD AND STUDIO CAMERAS
ROSS' SPECIAL HAND CAMERAS
ROSS' NEW ENLARGING LANTERNS
ROSS' PATENT SCIENCE LANTERNS
ROSS' NEW ECLIPSE MICROSCOPES
ROSS' IMPROVED TELESCOPES
ROSS' FIELD AND OPERA GLASSES
ROSS' NEW PRISMATIC BINOCULARS
&c., &c., &c.



ROSS, Ltd.,

(ESTAB. 1830.)

MANUFACTURING OPTICIANS,
111 NEW BOND ST., LONDON, W.,
AND
31 COCKSPUR ST., CHARING
CROSS, S.W.



IMPROVED D'ARSONVAL GALVANOMETERS.

PRICES
£10-0-0
AND
£4-10-0
LIBERAL DISCOUNTS.

Most
SENSITIVE
for
DEFECTIVE,
ZERO,
or
BALLISTIC
WORK.



Write for Price List and Particulars of Potentiometers, Galvanometers, Electrical Thermometers, Experimental Direct and Alternating Current Sets, &c., to

CROMPTON & CO., LD.,

Laboratory { "THRIPLANDS," } LONDON, W.
KENSINGTON COURT,

**NEW MODEL
PORTABLE
EQUATORIAL
MOUNTING**
For 3" or 3½"
TELESCOPES.



Latitude Adjustment, Clamp for Declination Axis, Quick and Slow Motion, in Right Ascension.

EQUATORIAL MOUNTING with Divided Circles and Stand fitted with short Iron Column, Levelling Screws, and Metal Stretcher, £15 15s.; or, complete with 3" Telescope, £25.

ILLUSTRATED CATALOGUE GRATIS.

J. H. STEWARD,
OPTICIAN.

406 STRAND, 457 WEST STRAND,
7 GRACECHURCH STREET. LONDON.

W. WILSON,

Makers of
SPECTROSCOPES, SPECTROMETERS,
GONIOMETERS,
OPTICAL BENCHES, OPTICAL AND OTHER
MEASURING INSTRUMENTS.
BEST WORK. MODERATE PRICES.

Price List Free.

1, BELMONT STREET, CHALK FARM, N.W.

BACTERIOLOGY.

SEND FOR PARTICULARS OF OUR
DPH No. 2 MICROSCOPE, complete at £18 18s.

TO

C. BAKER,

244 HIGH HOLBORN, LONDON.

Also our DPH No. 1 as supplied to the London School
of Tropical Medicine for

BLOOD EXAMINATION.

For Photography, Unsurpassed for fine definition.

COOKE LENSES

TAYLOR, TAYLOR, & HOBSON,
Stoughton Street Works, Leicester;
and 18 Berners Street, London, W.

THE CAMBRIDGE
SCIENTIFIC INSTRUMENT CO.
Ltd., CAMBRIDGE.

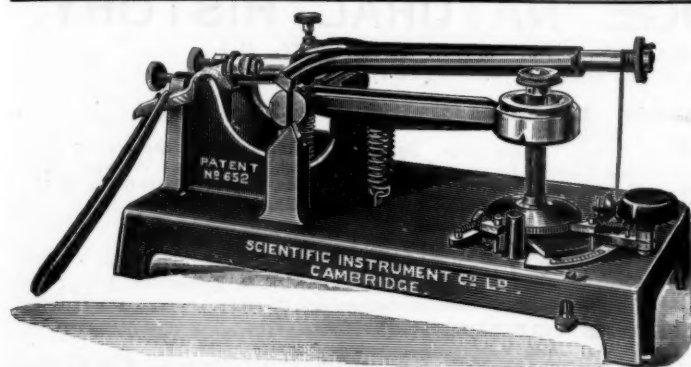
NEW ROCKING MICROTOME.
1900 PATTERN. [PATENTED.]

This Instrument possesses the following great improvements over the old type of instruments:—
(1) Increased rigidity. (2) The impossibility of cutting thin and thick sections. (3) The impossibility of tearing sections on the upward movement of the object. (4) A graduated arc for showing the thickness of the sections. (5) Catch for holding the object above the edge of the razor. (6) Improved method of fixing the cord. (7) A new object holder.

Price (including object holder), £5 0 0

Write for Pamphlet descriptive of the above Instrument.

Address all communications:—
INSTRUMENT COMPANY, CAMBRIDGE.



"No Better Food."

Dr. ANDREW WILSON, F.R.S.E., &c.

Fry's PURE CONCENTRATED **Cocoa**

250 Gold Medals and Diplomas.

N.B.—Just three words are necessary in order to obtain the right Cocoa,

viz. **FRY'S—PURE—CONCENTRATED.**

MACMILLAN & CO'S NEW AND RECENT BOOKS FOR STUDENTS OF ZOOLOGY.

AN ELEMENTARY COURSE OF PRACTICAL ZOOLOGY.

By the late **T. JEFFERY PARKER**, D.Sc., F.R.S., Professor of Biology in the University of Otago, Dunedin, New Zealand, and **W. NEWTON PARKER**, Ph.D., Professor of Zoology at the University College of South Wales and Monmouthshire, in the University of Wales. With 156 Illustrations. Crown 8vo. 10s. 6d.

A MANUAL OF ZOOLOGY.

By the late Prof. **T. J. PARKER**, D.Sc., F.R.S., and Prof. **W. A. HASWELL**, M.A., D.Sc., F.R.S.

With Three Hundred Illustrations. Crown 8vo, 10s. 6d.

KNOWLEDGE.—"The text is accompanied by about three hundred beautiful illustrations. . . . The treatment is explicit throughout, and the book is sure to gain a wide popularity."

FIELD.—"For those who require a manual to assist them in acquiring an accurate knowledge of zoology we know of no book superior to that under notice. . . . The illustrations are admirable. We know of no work better fitted to fulfil the purpose for which it was designed than the one under notice. It is an admirable introductory text-book to scientific zoology."

A TEXT-BOOK OF ZOOLOGY.

By **T. JEFFERY PARKER**, D.Sc., F.R.S.,

Professor of Biology in the University of Otago, Dunedin, N.Z., and **WILLIAM A. HASWELL**, M.A., D.Sc., F.R.S., Professor of Biology in the University of Sydney, N.S.W. In Two Vols. With Illustrations. Medium 8vo, 36s. net.

SCIENCE PROGRESS.—"The appearance of this important work, for which many of us have been eagerly waiting, will be hailed with pleasure. . . . When we consider the difficulties under which these authors laboured, one in New Zealand the other in Sydney, the printers, publishers and artists in England, one can only marvel at the splendid work they have produced, one that will be useful both to the elementary and advanced student alike, as well as to the teacher."

THE CAMBRIDGE NATURAL HISTORY.

EDITED BY **S. F. HARMER**, M.A., AND **A. E. SHIPLEY**, M.A.

TO BE COMPLETED IN TEN VOLUMES. 8vo. PRICE 17s. NET EACH.

WORMS, LEECHES, &c.

VOLUME II.

Flatworms. By **F. W. GAMBLE**, M.Sc. Vict., Owens College. **Nemertines.** By **Miss L. SHELDON**. **Threadworms, &c.** By **A. E. SHIPLEY**, M.A. **Rotifers.** By **Professor MARCUS HARTOG**, M.A., D.Sc. Lond. **Polychaet Worms.** By **W. BLAXLAND BENHAM**, D.Sc. Lond., Hon. M.A. Oxon. **Earthworms and Leeches.** By **F. E. BEDDARD**, M.A. Oxon., F.R.S. **Gephyrea, &c.** By **A. E. SHIPLEY**, M.A. **Polyzoa.** By **S. F. HARMER**, M.A.

NATURE.—"Taken as a whole the book is fully worthy of its place in this attractive series."

SHELLS.

VOLUME III.

Molluscs and Brachiopods. By the Rev. **A. H. COOKE**, M.A., **A. E. SHIPLEY**, M.A., and **F. R. C. REED**, M.A.

FIELD.—"We know of no book available to the general reader which affords such a vast fund of information on the structure and habits of molluscs."

INSECTS & CENTIPEDES.

VOLUME V.

Peripatus. By **ADAM SEDGWICK**, M.A., F.R.S. **Myriapods.** By **F. G. SINCLAIR**, M.A. **Insects. Part I.** By **DAVID SHARP**, M.A. Cantab., M.B. Edin., F.R.S.

ATHENÆUM.—"This book will find a place in the library of most entomologists, prove a welcome boon to weak brethren who are compelled to lecture—*docendo discimus*—and occupy by the side of Westwood's 'Modern Classification' and 'Burmester's Manual' a niche that has long been empty."

INSECTS.

VOLUME VI.

Part II. **Hymenoptera** continued (**Tubulifera** and **Aculeata**), **Coleoptera**, **Strepsiptera**, **Lepidoptera**, **Diptera**, **Aphaniptera**, **Thysanoptera**, **Hemiptera**, **Anoplura**. By **DAVID SHARP**, M.A. Cantab., M.B. Edin., F.R.S.

ENTOMOLOGIST'S RECORD.—"Too much cannot be said in praise of this work, which offers to the general naturalist, as well as to the specialist, a thoroughly reliable text-book that is distinctly in advance of any other work of a similar kind yet published in the English language."

BIRDS.

VOLUME IX.

By **A. H. EVANS**. With numerous Illustrations by **G. E. LODGE**.

NATURE NOTES.—"We venture to predict that, of the ten volumes of which this excellent series is planned to consist, none will secure a wider popularity than Mr. Evans' treatise on birds. Strange as it may appear, among the many books on birds that have appeared of late years, we do not recall any that covers the same ground. . . . We are grateful to the author for the mine of valuable information which he has crowded between his two covers."

* * The remaining five volumes, dealing with **PROTOZOA** (including **Sea Anemones**, **Jelly Fish**, **Star Fish**, &c.); **SPIDERS**, **SCORPIONS**, and **CRUSTACEA**; **FISHES** and **THEIR KINDRED**; **AMPHIBIA** and **REPTILES**; and **MAMMALS**, are all in active preparation.

MACMILLAN AND CO., LIMITED, LONDON.

PHŒNIX FIRE OFFICE,
9 LOMBARD ST., E.C., and 57 CHARING CROSS, S.W.

ESTABLISHED 1782.

MODERATE RATES. ABSOLUTE SECURITY.
ELECTRIC LIGHTING RULES SUPPLIED.
LIBERAL LOSS SETTLEMENTS.
PROMPT PAYMENT OF CLAIMS.
FRANCIS B. MACDONALD, SECRETARY.
LOSSES PAID OVER £22,000,000.

ESTABLISHED 1851.

BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

INVESTED FUNDS

£10,000,000.

The BIRKBECK ALMANACK, with full particulars, post free.

FRANCIS RAVENSCROFT, Manager.

PHYSIOGRAPHY and GEOLOGY.

COLLECTIONS & MICROSCOPIC SLIDES,

As advised by Science and Art Directory, arranged by

JAMES R. GREGORY & CO.,
Mineralogists, &c.

To Science and Art Department, British, Indian and Colonial
Museums, &c.

**NOVELTIES and RARE GEMS and PRECIOUS
STONES.**

Mineral Specimens for Museums, and Collectors, and all purposes.
Rock Specimens and Microscopic Sections of Rocks and Minerals
cut to order.

NEW AND VALUABLE MINERAL SPECIMENS CONSTANTLY
ARRIVING.

Stores & Offices: 1 Kelso Place, KENSINGTON, W.
NEW CATALOGUES AND LISTS FREE.

THE MOST NUTRITIOUS.

E P P S'S
GRATEFUL—COMFORTING.
C O C O A

BREAKFAST—SUPPER.

HOLLOWAY'S PILLS
CURE

Biliousness, Sick Headache, Indigestion, and
all Internal Complaints.

CAN BE TAKEN BY THE MOST DELICATE.

Holloway's Pills and Ointment may be obtained of
all Medicine Vendors.

THE IRISH NATURALIST.

A Monthly Magazine of Irish Zoology, Botany, and
Geology. Price 6d.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD
PRAEGER, B.A.

Annual Subscription, 5s. Post Free to any Address.

Dublin: EASON & SON, LTD., 40 Lower Sackville Street
(to which Address Subscriptions should be sent).

London: SIMPKIN, MARSHALL, HAMILTON, KENT, & CO., Ltd.

WATKINS & DONCASTER,

NATURALISTS,

AND MANUFACTURERS OF

CABINETS AND APPARATUS

FOR ENTOMOLOGY, BIRDS' EGGS, AND ALL BRANCHES OF
NATURAL HISTORY.

SPECIAL SHOW-ROOM FOR CABINETS.

Call or send for detailed Catalogue (66 pp.), Post free on
application.

N.B.—For Excellence and Superiority of Cabinets and
Apparatus, references are permitted to distinguished
patron Museums, Colleges, &c.

A LARGE STOCK OF INSECTS AND BIRDS' EGGS.

Birds, Mammals, &c., Preserved and Mounted by First-class Workmen
with true natural surroundings. All Books and Publications on Natural
History supplied.

36 STRAND, LONDON, W.C.

(Five Doors from Charing Cross.)

CABINETS

ENTOMOLOGICAL AND ALL BRANCHES OF NATURAL HISTORY

J. T. CROCKETT & SON are ACTUAL MAKERS.

Great advantages in dealing direct with them.

ALL BEST WORK. ESTIMATES GIVEN.

SEND for Full DETAILED PRICE LIST BEFORE ORDERING ELSEWHERE.

7a PRINCES STREET, CAVENTISH SQUARE, LONDON, W.

Factories: 34 Riding House Street and Ogle Street, W.

ALBERT EDWARD JAMRACH

(Late CHARLES JAMRACH),

NATURALIST,

180 ST. GEORGE STREET EAST.

Implements of Savage Warfare, Idols, Sacred Masks, Peruvian Pottery,
Netsukis China, Lacquers, Gongs, Shells, and other Curios.

MINERALS, ROCKS & FOSSILS.

COLLECTIONS FOR STUDENTS.

Carefully labelled and arranged in Boxes with Card Trays.

50 Minerals, 12/6; 100 do., 21/-; 200 do., 42/-.

Rocks and Fossils at similar prices.

300 Minerals in Cabinet, £4 4s.; 400 do., £5 12s. 6d.

Catalogues Post Free.

THOMAS D. RUSSELL,

78 NEWGATE STREET, LONDON, E.C.

**LIVING SPECIMENS FOR
THE MICROSCOPE.**

Volvox, Spirogyra, Desmids, Diatoms, Amoeba, Arcella, Actinosphaerium,
Vorticella, Stentor, Hydra, Filicula, Stephanoceros, Melicerta, and many
other Specimens of Pond Life. Price 1s. per Tube, Post Free. Helix
pomatia, Astacus, Amphioxus, Rana, Anodon, &c., for Dissection purposes.

THOMAS BOLTON,

25 BALSALL HEATH ROAD, BIRMINGHAM.

**MARINE BIOLOGICAL ASSOCIATION
OF THE UNITED KINGDOM.**

THE LABORATORY, PLYMOUTH.

The following animals can always be supplied, either living
or preserved by the best methods:—

Sycon; Clava, Obelia, Sertularia; Actinia, Tealia, Caryophyllia, Alcy-
onium; Hormiphora (preserved); Leptoplana; Lineus, Amphiporus; Nereis,
Aphrodite, Arenicola, Lanice, Terebella; Lepas, Balanus, Gammarus,
Ligia Mysis, Nebalia, Carcinus; Patella, Buccinum, Eledone, Pecten
Bugula, Crisia, Pedicellina, Holothuria, Asterias, Echinus; Ascidia, Salpa
(preserved), Scyllium, Raia, &c., &c.

For prices and more detailed lists apply to
Biological Laboratory, Plymouth.

THE DIRECTOR.

MACMILLAN & CO.'S NEW SCIENTIFIC BOOKS.

TEXT-BOOK OF PALÆONTOLOGY.

By KARL A. VON ZITTEL,

Professor of Geology and Palæontology in the University of Munich. Translated and Edited by CHAS. R. EASTMAN, Ph.D., Assistant in Palæontology in the Museum of Comparative Zoology at Harvard. With 1476 Woodcuts. Medium 8vo. 25s. net.

* * This English Edition is revised and enlarged by the Author and Editor in collaboration with numerous Specialists.

SPEAKER.—"In this sphere Prof. Zittel's books have long held the field as the standard works of their class, but to many they have been inaccessible on account of their being in a foreign tongue. . . . It has not merely been translated; it has been edited and brought up to date as well. . . . The author and editor have conferred a great boon upon their fellow-workers, whether English or foreign, by bringing out what is really a new edition of this work. . . . A most valuable addition to the scientific literature of the world, and the publication of the second volume, dealing with the Vertebrata, will be awaited with the keenest interest on all sides."

A HISTORY OF MODERN PHILOSOPHY: a Sketch of the History of Philosophy from the Close of the Renaissance to our own Day. By Dr. HARALD HÖFFDING. Translated from the German by B. E. MEYER. In 2 Vols., 8vo, 15s. net each Volume.

OUTLOOK.—"The student could wish for no juster or more dependable *vade mecum*."

VOL. III. (COMPLETING THE WORK) NOW READY.

DICTIONARY OF POLITICAL ECONOMY. Edited by R. H. INGLIS PALGRAVE. Vol. III. (completing the work). Medium 8vo, 21s. net. Also ready, Vols. I. and II., 21s. net each.

STATIST.—"Brings to completion an excellent cyclopædia of all matters pertaining to political economy."

DEMOCRACY AND EMPIRE, WITH STUDIES OF THEIR PSYCHOLOGICAL, ECONOMIC, AND MORAL FOUNDATIONS. By FRANKLIN HENRY GIDDINGS, M.A., Ph.D., Professor in Columbia University, New York. 8vo. 8s. 6d. net.

MONOPOLISTS AND TRUSTS. By RICHARD T. ELY, Ph.D., LL.D., Professor of Political Economy and Director of the School of Economics, Political Science, and History in the University of Wisconsin. Crown 8vo. 5s. net. [The Citizen's Library.]

THE PRINCIPLES OF MECHANICS PRESENTED IN A NEW FORM. By HEINRICH HERTZ, late Professor of Physics in the University of Bonn. With an Introduction by H. von HELMHOLTZ. Authorised English Translation by D. E. JONES, B.Sc., District Inspector under the Department of Science and Art, &c., and J. T. WALLEY, M.A. 8vo. 10s. net.

ENGINEER.—"A very remarkable book. . . . A book which it is impossible to pass over in silence, fraught as it is with infinite possibilities of the future. It represents the latest work of one of the finest intellects of the century."

INTRODUCTION TO PHYSICAL CHEMISTRY. By JAMES WALKER, D.Sc., Ph.D., Professor of Chemistry in University College, Dundee. 8vo. 10s. net.

LANCET.—"The book is written in such a lucid way as to render its perusal free from that irksomeness which is so often the student's experience when confronted with theoretical considerations. The book should serve as an admirable introduction to more advanced works."

THE THEORY OF ELECTROLYTIC DISSOCIATION AND SOME OF ITS APPLICATIONS. By HARRY C. JONES, Associate in Physical Chemistry in Johns Hopkins University. Extra crown 8vo. 7s. net.

THE NATURE AND WORK OF PLANTS. An Introduction to the Study of Botany. By DANIEL TREMBLY MACDOUGAL, Ph.D., Director of the Laboratories, New York Botanical Garden. Crown 8vo. 4s. 6d.

MACMILLAN AND CO., LIMITED, LONDON.

NOTICE.—Advertisements and business letters for NATURE should be addressed to the Publishers; Editorial communications to the Editor. The telegraphic address of NATURE is "PHUSIS," LONDON.

SUBSCRIPTIONS TO "NATURE."

	£	s.	d.
Yearly	1	8	0
Half-yearly	0	14	6
Quarterly	0	7	6
TO ALL PLACES ABROAD:—			
Yearly	1	10	6
Half-yearly	0	15	6
Quarterly	0	8	0

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
*Three Lines in Column	0	2	6
Per Line after	0	0	9
One Eighth Page, or Quarter Column	0	18	6
Quarter Page, or Half a Column	1	15	0
Half a Page, or a Column	3	5	0
Whole Page	6	6	0

* The first line being in heavy type is charged for as Two Lines.

Cheques and Money Orders payable to MACMILLAN & CO., Limited.

OFFICE: ST. MARTIN'S STREET, LONDON, W.C.

NOTICE.—SPECIAL RE-ISSUE BY NATURE
OF THE
INTERNATIONAL SCIENTIFIC SERIES
FOR A STRICTLY LIMITED PERIOD.
EIGHTY-SIX VOLUMES.

**A COMPLETE LIBRARY OF SCIENCE AT
A GREATLY REDUCED PRICE.**

PUBLISHERS' PRICE	...	...	...	...	£21	10	0
BY INSTALMENT (TO-DAY)	...	...	...	...	£14	14	0
FOR CASH	...	...	...	...	£13	10	0

The "International Scientific Series" has a world-wide reputation, and is to be found in every well-equipped Library throughout the English-speaking world. No more generous or acceptable present could be made to any Public Library or individual than this magnificent Encyclopædia of Scientific Research.

Most of the works are illustrated, and many with beautiful coloured plates. The Series has been contributed to by men of science of the highest eminence, such as Tyndall, Herbert Spencer, Walter Bagehot, Alexander Bain, Stanley Jevons, Huxley, Sir John Lubbock, G. J. Romanes, Balfour Stewart, Sir Norman Lockyer, Draper, Bonney, Sir Hubert Parry, Sir E. Maunde Thompson. This list only professes to convey a slight idea of the attention that has been given to the whole Series by the selection of only the best writers to deal with the various subjects considered.

This special offer is open only for a short time, and intending purchasers will do well therefore to send their orders without delay.

For the benefit of those who do not feel disposed to buy the entire Series, it will be possible to secure half the Series, making 43 volumes, for £7 cash, or £7 7s. on the instalment system, the purchaser himself selecting the volumes. The whole Series or half, as the case may be, will be sent on receipt of the first payment of One Guinea—the rest to be paid at the rate of £1 1s. per month.

NOTE:—OFFER OPEN ONLY FOR A SHORT TIME.
ORDER AT ONCE.

A Set of the Volumes may be seen at the Office of NATURE, ST. MARTIN'S STREET, W.C.

A Pamphlet, giving titles, &c., of the Works in the Series, Specimen Pages, with Illustrations, of some of the Volumes, also Order Form, will be sent Post Free on application to

C. WORSFOLD, "NATURE" Office, St. Martin's Street, London, W.C.

ORDER FORM.

Date.....1900.

All cheques should be crossed and made payable to C. WORSFOLD, "NATURE" Office, St. Martin's Street, W.C.

I enclose One Guinea as first payment for "NATURE'S Re-issue of the International Scientific Series," and I agree to pay to you, or your representative, the balance at the rate of One Guinea per month; my next payment to be on delivery of the volumes, and my remaining payments on the corresponding day of each month following.

Until such payments are complete, I engage that the Works, not being my property, shall not be disposed of by sale or otherwise.

I further agree that if it be found impossible for any reason to deliver the books, the return of the sum of One Guinea to me shall cancel this agreement.

Name.....

Address.....

Residents abroad are kindly requested to remit in full, or to instruct their representatives in England to make the monthly payments, in order to avoid the expense and delay in forwarding cash from abroad.

The.. **'N. & G.' Cameras**

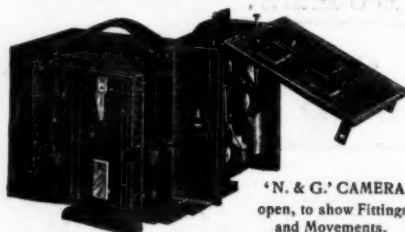
In all sizes up to 7 x 5 in.
For Plates, Cut Films, or Film
in Spools.

For hand and Tripod.

A Series of High-Class Instruments for *Serious Work*,
embodying every New Advance in Photography.

Prices from £13 to £50.

Have been in Constant Use for *Eight Years* in all parts of the World.



'N. & G.' CAMERA,
open, to show Fittings
and Movements.

TRIPOD CAMERAS, SURVEYING CAMERAS, and very Small and
Light POCKET CAMERAS for Travellers and Field Naturalists.

Speciality: COMPLETE OUTFITS for Scientific Expedi-
tions and Special Research.

Catalogues and Estimates + Lenses, Kinematographs, Lanterns, and all
free on application. Photographic Accessories and Materials.

Newman & Guardia, Ltd.

90 & 92 Shaftesbury Avenue, London, W.

C. E. MÜLLER & CO., **SCIENTIFIC** **GLASS BLOWERS**

AND MANUFACTURERS OF

CHEMICAL & PHYSICAL APPARATUS.

ALL KINDS OF

EXPERIMENTAL WORK

CARRIED OUT TO DESCRIPTION
FOR

SCIENCE WORKERS,

LABORATORIES, &c.

AT MODERATE RATES.

ILLUSTRATED LISTS OF APPARATUS IN
STOCK ON APPLICATION.

List of **BALANCES** also Post Free.

148 HIGH HOLBORN,
LONDON, W.C.

OPPOSITE THE BRITISH MUSEUM.

THACKERAY HOTEL

(TEMPERANCE),

GREAT RUSSELL STREET, LONDON.

THIS newly-erected and commodious Hotel will, it is believed, meet the requirements of those who desire all the conveniences and advantages of the larger modern licensed hotels at moderate charges. Passenger Lift. Electric Light in all Rooms. Bath-rooms on every Floor. Spacious Dining, Drawing, Writing, Reading, and Smoking Rooms. All Floors Fireproof. Perfect Sanitation. Night Porter. Telephone. Bedrooms from 2s. 6d. to 4s. 6d. per night. Full Tariff and Testimonials on application.

Telegraphic Address: "THACKERAY, LONDON."

Proprietor—J. TRUSLOVE.

Also, amalgamated with, and under the same management,

ESMOND HOTEL

(TEMPERANCE),

MONTAGUE STREET, RUSSELL SQUARE.

THIS Hotel, which has been carried on so successfully for the last 13 years, adjoins the British Museum, and is exception-
ally quiet. Bedrooms from 2s. to 3s. 6d. per night. Full Tariff and Testimonials on application.

Telegraphic Address: "TRUSLOVE, LONDON."

Proprietor—J. TRUSLOVE.

TO SCIENTIFIC MEN, NATURALISTS, TRAVELLERS, AND OTHERS.

THE STEREOSCOPIC COMPANY

CAN SPECIALLY
RECOMMEND ANY OF
THE FOLLOWING
HAND CAMERAS.



ADDRESS—
106 & 108 RECENT ST., W.,
and 54, Cheapside, E.C.

THE TWIN-LENS ARTIST,

with full size Focussing
Finder, Rapid Euryscope
Lenses, Time and Instanta-
neous Shutter, Rising Front,
Focussing Adjustment,
Double Dark Slides,
Magazine or Cartridge
Roll Holders.

1-p. complete, with	£ s.
3 Slides	14 74
5x4 complete, with	
3 Slides	16 16
1-p. complete, with	
3 Slides	21 0

THE TWIN-LENS ARTIST,

with
MAGAZINE
for 12 Plates or
24 Films,
&c., &c.,
as described.

1-p. complete...	£ s.
15 15	
5x4 " "	17 17
1-p. " "	22 3

THE TWIN-LENS CARLTON,

Carrying 12 Plates
or Films,
and now so well known
as not to
need description.

PRICE:	£ s.
1-p. complete...	12 12
5x4 " "	15 15
1-p. " "	21 0

PLEASE READ

Extract of Letter from
R. BOWDLER SHARPE,
Esq., LL.D.,
Assist. Keeper Zoological
Dept., British Museum,
March 4, 1898:—
"I consider it one of the
best day's work I ever did
when I bought one of your
Cameras. The ease with
which it is worked, and the
excellent results obtained,
make it a most pleasurable
accompaniment of a summer's
outing."

**FREE LESSONS TO
PURCHASERS.**

Printed by RICHARD CLAY AND SONS, LIMITED, at 7 & 8 Bread Street Hill, Queen Victoria Street, in the City of London and published by MACMILLAN
AND CO., LIMITED, at St. Martin's Street, London, W.C., and THE MACMILLAN COMPANY, 66 Fifth Avenue, New York.—THURSDAY, March 15 1900.



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 1586, VOL. 61]

THURSDAY, MARCH 22, 1900.

[PRICE SIXPENCE.

Registered as a Newspaper at the General Post Office.]

[All Rights are Reserved.

NEWTON & CO.,

SCIENTIFIC INSTRUMENT
MAKERS
TO HER MAJESTY THE
QUEEN
AND THE GOVERNMENT.



PHILOSOPHICAL INSTRUMENT
MAKERS BY SPECIAL
APPOINTMENT TO THE
ROYAL INSTITUTION OF
GREAT BRITAIN.

Makers of every description
of OPTICAL and
PHYSICAL APPARATUS
of the highest class,
for Colleges, Institutions,
&c.

Catalogue of
OPTICAL LANTERNS,
PROJECTION APPARATUS,
and SLIDES, &c.

WIMSHURST ELECTRICAL MACHINES.

Best Quality, 12 in., 60s.; 15 in., £5 10s.; 18 in., £6 10s. Multiple-Plate
Machines, £22 to £150. As made for the Science and Art Department,
and the Universities of Oxford, Cambridge, London, Sydney,
N.S.W., McGill, Montreal, &c.

3 FLEET STREET, TEMPLE BAR, LONDON, E.C.

BECK'S

NEW

MICROSCOPE

THE

"BRITISH STUDENTS."

Microscope Stand No. 55, as
figured, with Iris Diaphragm,
One Eye-piece; Double Nose-
piece, Two Object-glasses, 2/3"
and 1/8", adjusted to be in
about focus, and the whole
packed in polished Mahogany
Case.

£6 : 8 : 6



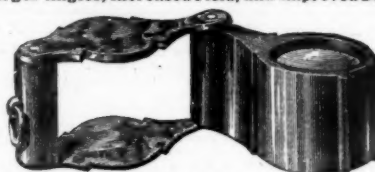
No. 55.

R. & J. BECK, Ltd.,

68 CORNHILL, LONDON, E.C.

BROWNING'S PLATYSCOPIC LENS.

With Larger Angles, Increased Field, and Improved Definition.



Engraved Real Size.

AN ACHROMATIC COMBINATION.

COMBINING THE DEFINITION OF A MICROSCOPE WITH THE
PORTABILITY OF A POCKET LENS.

"If you carry a small Platyscopic Pocket Lens (which every observer of
Nature ought to do)."—GRANT ALLEN in *Knowledge*.

The Platyscopic Lens is invaluable to botanists, mineralogists, or ento-
mologists, as it focuses about three times as far from the object as the
Coddington Lenses. This allows opaque objects to be examined easily.

The Platyscopic Lens is made of four degrees of power, magnifying
respectively 10, 15, 20, and 30 diams.; the lowest power, having the largest
field, is the best adapted for general use.

The Lenses are set in Ebonite Cells, and mounted in Tortoiseshell Frames.

Price of the Platyscopic Lens, mounted in Tortoiseshell, magnifying either
10, 15, 20, or 30 diameters, each power, 15s.

In nickelised German Silver, each power, 17s. 6d.

Illustrated Description sent free.

JOHN BROWNING, 63 STRAND, LONDON, W.C.

NEGRETTI & ZAMBRA'S

LONG RANGE BINOCULARS AND TELESCOPES

FOR MILITARY PURPOSES.

ILLUSTRATED PRICE LISTS FREE BY POST TO
ALL PARTS OF THE WORLD.

SPECIAL TERMS TO YEOMANRY TROOPS AND VOLUNTEER
CORPS REQUIRING SEVERAL GLASSES.



THE
"READY-FOCUS"
BINOCULAR.

A great
improvement over the ordinary system
of Focussing.

Invaluable in watching moving
objects.

NEGRETTI & ZAMBRA,

SCIENTIFIC INSTRUMENT MAKERS TO THE QUEEN,
38 HOLBORN VIADUCT, E.C.

BRANCHES: 45 CORNHILL; 122 REGENT STREET.

THE DAVY-FARADAY RESEARCH LABORATORY

OF THE

ROYAL INSTITUTION.

DIRECTORS:

The Right Hon. LORD RAYLEIGH, M.A., D.C.L.,
LL.D., F.R.S.

Professor DEWAR, M.A., LL.D., F.R.S.

SUPERINTENDENT OF THE LABORATORY:

Dr. ALEXANDER SCOTT, M.A., D.Sc., F.R.S.

This Laboratory was founded by Dr. Ludwig Mond, F.R.S., as a Memorial of Davy and Faraday, for the purpose of promoting, by original research, the development and extension of Chemical and Physical Science.

The Laboratory is open free of charge to Workers of either sex, and any nationality, prosecuting individual investigations; and the extensive collection of Physico-Chemical Apparatus presented by the Founder is available for their use, together with such materials, chemicals, electricity, &c., as the Directors may authorise.

Assistants and a trained mechanic are attached to the Laboratory to aid Workers in the prosecution of their researches.

All persons desiring to be admitted as Workers must send evidence of scientific training, qualification, and previous experience in original research, along with a statement of the nature of the investigation they propose to undertake.

Michaelmas Term.—Monday, October 2, to Saturday, December 16.

Lent Term.—Monday, January 8, to Saturday, April 7.

Easter Term.—Monday, April 30, to Saturday, July 28.

Forms of Application can be had from the ASSISTANT SECRETARY, Royal Institution, Albemarle Street, W.

GLASGOW ROYAL INFIRMARY.

The SUMMER SESSION opens on APRIL 24, 1900. The number of beds, including the Ophthalmic Department, is 612.

Special Wards and Beds are set apart for the treatment of the Diseases of Women, of the Throat and Nose and of the Ear; and there is a specially well-equipped department for the treatment of Diseases and Injury of the Eye. Women Students are admitted to the Clinical Teaching and Practice of the Infirmary; Medical and Surgical Wards being set apart for their exclusive use.

HOUSE APPOINTMENTS.—Five House Physicians and Seven House Surgeons are elected every six months, and an Assistant to the Gynaecologist, who boards but is non-resident, is elected at the same time. Women are eligible for this appointment.

Dressers, Clinical Clerks, and Assistants to the Pathologist are selected from the Students.

BURSARIES.—The David Foulis Scholarship and the John Reid Prize, value £25 each, are open to Students of the Royal Infirmary.

Fees, which include Hospital Practice and the Clinical Lectures—for one year, £10 10s; six months, £6 6s; Three Months, £4 4s. The total fee is £21. Vaccination, £1 1s. Pathology, £4 4s. Bacteriology, £2 2s.

For further information apply to

M. THOMAS, M.D., Superintendent.

ST. THOMAS'S HOSPITAL MEDICAL SCHOOL,

ALBERT EMBANKMENT, S.E.

The SUMMER SESSION will commence on TUESDAY, May 1. Students entering in the Summer are eligible to compete for the Science Scholarships of £150 and £60 awarded in October.

A Scholarship of £50, open to University Students, and other Prizes and Scholarships of the value of £500 are offered for annual competition. All appointments are open to Students without extra payment.

Special Classes for the Examinations of the University of London are held throughout the year.

Tutorial Classes are held prior to the Second and Final Examinations of the Conjoint Board in January, April, and July.

A Register of approved lodgings and of private families receiving Boarders is kept in Secretary's Office.

Excellent Day Club accommodation is provided in the School Building, and an Athletic Ground at Chiswick.

Prospectuses and all particulars may be obtained from the Medical Secretary, Mr. G. RENDLE.

H. P. HAWKINS, M.A., M.D.Oxon., Dean.

FLAT SKELETONS OF SMALL ANI-

MALS AND BIRDS, made and mounted in Glass-topped Boxes, by Miss T. SMITH, Sladen Mount, Arnside, Westmoreland. Prices on application.

BOTANICAL MATERIAL FOR CLASS WORK, RESEARCH AND PRIVATE STUDENTS.

J. BACKHOUSE & SON, LIMITED, YORK.

Having now established their new Scientific Department and Experimental Laboratory, are prepared to send Post free on application their new

50 PAGE CATALOGUE,

comprising Cryptogamic and Phanerogamic Material, fresh or preserved; Museum Specimens; Microscopical Preparations; &c., &c.

BIRKBECK INSTITUTION,

Breams Buildings, Chancery Lane, E.C.

Science Classes with Practical Work.

DAY AND EVENING CLASSES for University of London B.Sc.; Prelim. Scientific, Inter. M.B. Examinations and for Conjoint Board, Dental and Pharmaceutical Examinations.

EVENING CLASSES in all stages for Science and Art Department Examinations.

HIGHLY-EQUIPPED LABORATORIES.

Chemistry, Physics, Biology (Zoology and Botany), Metallurgy, Geology and Mineralogy, Microscopy.

Prospectus free. Calendar 6d. (Post 8d.) on application to Secretary.

HEATHCOTE SCIENCE LABORATORIES.

These Laboratories are open for RESEARCH work, at any hours or times most convenient for workers, in CHEMISTRY, PHYSICS and BACTERIOLOGY. Facilities for Commercial investigations are supplied. Furnaces and powerful Electrical Currents can be used.

The Fees are at rate of £3 3s. for one month (five days a week, six hours a day). Apparatus supplied free.

Private Laboratory, £4 14s. 6d. a month, or by arrangement.

The above Fees include use of all ordinary Glass and other Apparatus, and use of Accurate Balances and Standard General Instruments, also Furnaces, &c.

9 Heathcote Street, Mecklenburgh Square,
Gray's Inn Road, W.C.

R. C. T. EVANS,
Director.

WANTED, for the National Physical

Laboratory, a LABORATORY ASSISTANT and MECHANIC. Applicants should have had experience both in an Instrument Maker's Shop and in a Laboratory. Some knowledge of Glass-blowing and Pattern making is also desirable. Applications, stating age, qualifications and salary required, and giving references, should be made by letter addressed to the DIRECTOR, National Physical Laboratory, Old Deer Park, Richmond.

LETCHER & SONS (formerly Letcher Bros.),

SCIENTIFIC INSTRUMENT MAKERS,

25 TURNPIKE LANE, HORNSEY, N.

BLOWPIPE CABINETS. SPECIALITY: SOCIETY OF ARTS SETS.

PRICE LIST, POST FREE, ON APPLICATION.

Sale by Auction.

TUESDAY AND WEDNESDAY, MARCH 27 AND 28.

THE "SAMUEL STEVENS" COLLECTION.

MR. J. C. STEVENS begs to announce that

he has received instructions from the Executors to Sell by Auction, at his Great Rooms, 38 King Street, Covent Garden, on Tuesday and Wednesday, March 27 and 28, the well-known Collection of British Lepidoptera, formed by the late SAMUEL STEVENS, Esq., the result of over sixty years' collecting and breeding; consisting probably of over 100,000 specimens, and amongst them some wonderful and exceptional varieties of a very large number of species, and a long series of many rare and extinct species too numerous to mention.

On view day prior, to till 4. Catalogue in preparation, and can be had on application.

BARGAINS IN SCIENTIFIC BOOKS.

BREHM (A. E.), FROM NORTH POLE

TO EQUATOR, Studies of Wild Life and Scenes in many Lands, by the Naturalist Traveller, ALFRED EDMUND BREHM, Author of "Bird Life," "Tierleben," &c. Translated from the German by MARGARET R. THOMSON. Edited by J. ARTHUR THOMSON, M.A., F.R.S.E. With Eighty-Three Illustrations from Original Drawings, Super Royal, 8vo, Cloth, Gilt (pub. 21s.). 5s.

"Among the multitude of good books on natural history now issuing from the Press, this deserves a high place. It is both informing and entertaining."—*The Times*.

"The work contains many excellent descriptions of the scenery, people, and customs of the various countries in which the author travelled. The capital description of Nubia and the Nile Rapids, and of the desert tribesmen, derives additional interest from the fact that a new Anglo-Egyptian expedition is now marching to the Soudan."—*Daily News*.

"A fascinating volume of travel by the late well-known German naturalist, Alfred Brehm. . . . The present book is in many respects remarkable, and not least for the minuteness of its observation of birds and beasts in almost every quarter of the globe. The illustrations are many, and, like the translation, they are excellent."—*Speaker*.

NEWMAN (EDWARD, F.Z.S.), ILLUSTRATED NATURAL HISTORY OF BRITISH BUTTERFLIES AND MOTHS, giving a full Description of the Perfect Insect from Nature; also a Description of the Caterpillar, Chrysalis, Food Plant, Time of Appearance, and Localities where Found, Illustrated with nearly 900 Life-Size Figures of every Species of Moth and Butterfly, accurately drawn from Nature by GEORGE WILLS, and engraved by JOHN KERCHNER, in his best style, a handsome volume, Super Royal 8vo, Cloth (pub. 25s.). 12s.

Or in Two Parts, as follows:—

— **BUTTERFLIES** (pub. 7s. 6d.). 5s.

— **MOTHS** (pub. 20s.). 8s. 6d.

"For this useful and valuable contribution to popular natural history—in the highest acceptance of the word 'popular'—Mr. Newman has our hearty thanks."—*Science Gazette*.

"His work is distinguished by the great prominence given in it to the Natural History of the Species. The illustrations are very numerous, including figures of all the species and of both sexes when there is any difference either in the upper or lower surface."—*Nature*.

Postage 6d. extra on one, or 9d. on two.

H. J. GLAISHER, New and Remainder Bookseller, 57 Wigmore Street, London, W.

Catalogues Post Free on application.

J. & A. CHURCHILL'S LIST.

THE NEW ALGEBRA.

ELEMENTARY ALGEBRA (TO QUADRATICS). By C. H. FRENCH, M.A., and G. OSBORN, M.A., Mathematical Masters at the Leys School, Cambridge, formerly Scholars of Emmanuel College, Cambridge. Crown 8vo, 3s. 6d.; or with Answers, 4s. 6d.

"More complete, and on the whole more helpful to a beginner, than any with which we are acquainted."—*Practical Teacher*.

"Wonderfully clear and simple."—*Journal of Education*.

"Always correct."—*Academy*.

ELEMENTARY PRACTICAL CHEMISTRY AND QUALITATIVE ANALYSIS. By Professors CLOWES and COLEMAN. Third Edition, with 68 Engravings, post 8vo, 3s. 6d. [Just ready.]

PRACTICAL CHEMISTRY and QUALITATIVE ANALYSIS. By Professor CLOWES. Seventh Edition, with 101 Engravings, post 8vo, 8s. 6d.

A HANDBOOK OF PHYSICS AND CHEMISTRY, adapted to the Requirements of the First Examination of the Conjoint Board of the Royal Colleges of Physicians and Surgeons, and also for General Use. By HERBERT E. CORBIN, B.Sc. Lond., and ARCHIBALD M. STEWART, B.Sc. Lond. With 120 Illustrations. Crown 8vo, 6s. 6d.

"An excellent course of physics and chemistry. . . . We can strongly recommend it."—*University Correspondent*.

A MANUAL OF CHEMISTRY, THEORETICAL AND PRACTICAL. By WILLIAM A. TILDEN, D.Sc., F.R.S., Professor of Chemistry in the Royal College of Science, London; Examiner in Chemistry to the Department of Science and Art. With 2 Plates and 143 Woodcuts. Crown 8vo, 10s.

A MANUAL OF BOTANY. By J. Reynolds GREEN, Sc.D., F.R.S., Professor of Botany to the Pharmaceutical Society; Examiner in Botany to the University of London and the Victoria University. In Two Vols., with nearly 1200 Illustrations. Vol. I. MORPHOLOGY AND ANATOMY. Second Edition. 7s. 6d. Vol. II. CLASSIFICATION AND PHYSIOLOGY. 10s.

London: J. & A. CHURCHILL, 7 Great Marlborough St.

VOLUME I. NOW READY.

With 44 Plates. Demy 4to. Price 40s. net.

THE NORWEGIAN NORTH POLAR EXPEDITION

1893–1896

SCIENTIFIC RESULTS.

Edited by FRIDTJOF NANSEN.

VOLUME I.

- | | |
|------------------------------|--|
| I. COLIN ARCHER | ... The Fram. |
| II. J. F. POMPECKJ | ... The Jurassic Fauna of Cape Flora. With a Geological Sketch of Cape Flora and its Neighbourhood by Fridtjof Nansen. |
| III. A. G. NATHORST | ... Fossil Plants from Franz Josef Land. |
| IV. R. COLLETT and F. NANSEN | ... An Account of the Birds. |
| V. G. O. SARS | ... Crustacea. |

*. The aim of this Report (which will be published in English only) is to give, in a series of separate Memoirs, a complete account of the scientific results of the Norwegian Polar Expedition, 1893–1896. The whole work is estimated to form five or six quarto volumes, which it is hoped will be finished in the course of about two years.

LONDON, NEW YORK, AND BOMBAY: LONGMANS, GREEN, & CO. CHRISTIANA: JACOB DYBWAD. LEIPZIG: F. A. BROCKHAUS.

THE SCIENTIFIC ROLL AND MAGAZINE OF SYSTEMATIZED NOTES.

THIS WORK IS A VALUABLE

GUIDE, BIBLIOGRAPHY, AND INDEX TO SCIENCE.

In preparation.

BACTERIA (Botanical Section).

Although these are the simplest of plants, there is probably no group of organisms which exceeds them in interest or importance. Their operations affect the *welfare of every member of the community*, as also of the whole organic world. A full knowledge of them is essential in all questions bearing upon public and private health, agriculture, the microbial diseases of animals and of plants; and it is important in many industries, such as those dealing with milk, butter, hay, flax, tobacco, and others.

The group will be dealt with in three octavo volumes of about 500 pp. each. The subscription price will be 10s. for each volume, payable on delivery of the first number of the volume; or arrangements may be made to supply only the portions relating to a particular species, genus, or topic, at a proportionately reduced rate. The first volume will be commenced next summer, and if sufficient subscribers support the work, the three volumes will be completed in three years. As all the matter will be systematized, the series will be equivalent to a good bacteriological library, with the advantage that the information on any particular point will be comprised within a comparatively few pages, and not scattered over thousands of pages in a host of journals and books.

The names and addresses of subscribers, and applications for prospectus may be sent to the undersigned.

The undersigned will be glad to hear from PRINTERS willing to give estimates for printing, and from PUBLISHERS willing to consider terms for publishing the above-mentioned work.

A. RAMSAY,
4 Cowper Road, Acton, London, W.

JOURNAL OF THE INSTITUTION OF ELECTRICAL ENGINEERS.

Edited by W. G. McMILLAN, Secretary.

PART NO. 143.

Containing the "REPORT ON THE INSTITUTION VISIT TO SWITZERLAND IN 1899," with the discussion thereon; and the following Papers with their respective discussions:—

"The Utilisation of the Schaffhausen Water Power," by ALFRED AMSLER, Ph.D.; and "AN ELECTROLYTIC CENTRIFUGAL PROCESS FOR THE PRODUCTION OF COPPER TUBES," by S. COWPER COLES, Member; together with Continuation of Discussion on "ELECTRICAL TIME SERVICE."

Price 2s. 6d.

E. & F. N. SPON, LIMITED, 125 STRAND, W.C.

WATKINS & DONCASTER,
NATURALISTS,
AND MANUFACTURERS OF
CABINETS AND APPARATUS
FOR ENTOMOLOGY, BIRDS' EGGS, AND ALL BRANCHES OF
NATURAL HISTORY.

SPECIAL SHOW-ROOM FOR CABINETS.

Call or send for detailed Catalogue (66 pp.), Post free on application.

N.B.—For Excellence and Superiority of Cabinets and Apparatus, references are permitted to distinguished patrons, Museums, Colleges, &c.

A LARGE STOCK OF INSECTS AND BIRDS' EGGS.

Birds, Mammals, &c., Preserved and Mounted by First-class Workmen with true natural surroundings. All Books and Publications on Natural History supplied.

36 STRAND, LONDON, W.C.
(Five Doors from Charing Cross.)

MINERALS, ROCKS & FOSSILS.
COLLECTIONS FOR STUDENTS.

Carefully labelled and arranged in Boxes with Card Trays.
50 Minerals, 12/6; 100 do., 21/-; 200 do., 42/-.

Rocks and Fossils at similar prices.

300 Minerals in Cabinet, £4 4s.; 400 do., £5 12s. 6d.

Catalogues Post Free.

THOMAS D. RUSSELL,
75 NEWGATE STREET, LONDON, E.C.

PHŒNIX FIRE OFFICE,
9 LOMBARD ST., E.C., and 57 CHARING CROSS, S.W.
ESTABLISHED 1782.

MODERATE RATES. ABSOLUTE SECURITY.

ELECTRIC LIGHTING RULES SUPPLIED.

LIBERAL LOSS SETTLEMENTS.

PROMPT PAYMENT OF CLAIMS.

FRANCIS B. MACDONALD, SECRETARY.

LOSSES PAID OVER £22,000,000.

ESTABLISHED 1851.
BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

INVESTED FUNDS

£10,000,000.

The BIRKBECK ALMANACK, with full particulars, post free.

FRANCIS RAVENSCROFT, Manager.

T. TAMBLYN-WATTS,
SCIENTIFIC APPARATUS MAKER.

Catalogue of Electrical Apparatus and Materials, 6d. Post free.
Catalogue of Balances and Weights, Apparatus for the Study
of Mechanics, &c., 6d. Post free.

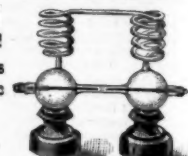
GOLDIELANDS, SETTLE, YORKS.

GLASS BLOWING.

All kinds of Experimental Glass
Blowing carried out for Scientific
Men, Laboratories, &c.

INVENTORS' IDEAS WORKED OUT AS PER INSTRUCTIONS.

COSSOR,
67 FARRINGTON ROAD, E.C.



Hittorf's Tube showing the
resistance of the dark space.

SECOND-HAND MICROSCOPES

By SWIFT, WATSON, CROUCH, BECK, ZEISS, LEITZ, &c.
Prices from £2 10s. to £45.

A Large Selection of Second-hand Powers and Fittings for all kinds of
Microscopes.

Send for New List.

CLARKSON & CO., 28 Bartlett's Buildings, Holborn Circus, E.C.

TO SCIENCE LECTURERS.
HUGHES' MOTO-PHOSCOPE FOR LIVING PICTURES.
THE MOST PERFECT.

No SHUTTER, therefore no Flickering. Superb Mechanism.

The Moto-Photo Camera for taking the Pictures. Illustrated Lists, ad.

See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN &c. Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great success. New Oxyhydrogen Microscope. Science Lanterns for Class Demonstration. Magnificent Results. Docwra Triple, Prize Medals Highest Award. Supplied to the Royal Polytechnic Institution, Dr. H. GRATTAN GUINNESS, Madame ADELINA PATTI, &c., &c. Patent Pamphengo, Science Lanterns. The Universal Lantern 4-inch Condensers, 4-wick Lamp, Portrait Combination front Lenses, 18s. 6d., Marvellous value. Science Lecture Sets. Novelities. The Lantern Kaleidoscope. Cheapest Lantern Outfits in the World. Grandly Illustrated Catalogue, over 180 choice Engravings, 6d.; Postage, 3d. List of 300 Lecture Sets, Science Subjects, Views, &c., 6d.; Postage ad. Pamphlets Free. W. C. HUGHES, SPECIALIST, Brewster House, 8a Mortimer Road, Kingland, N.

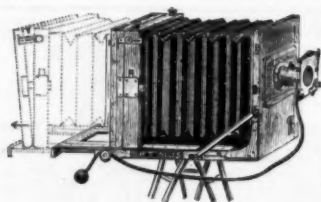
ALBERT EDWARD JAMRACH
(Late CHARLES JAMRACH),
NATURALIST,
180 ST. GEORGE STREET EAST.

Implements of Savage Warfare, Idols, Sacred Masks, Peruvian Pottery, Netsukis China, Lacquers, Gongs, Shells, and other Curios.

TRADE
MARK

"OPTIMUS."

TELEGRAPHIC
ADDRESS.

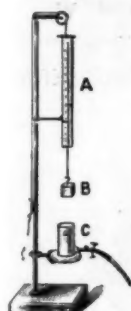


**PHOTOGRAPHIC
APPARATUS**
OF BEST WORKMANSHIP
FOR ALL PURPOSES.



Catalogue POST FREE.

PERKEN, SON & CO., LTD., 99, HATTON GARDEN, LONDON.

MOORE'S HYDROSTATIC BALANCE

FOR ILLUSTRATING THE "PRINCIPLE OF ARCHIMEDES" AND SPECIFIC GRAVITY.

A is a delicate spring balance accurately graduated to read Grams, and is capable of being lowered or raised by the string shown.

B is one of the set of cubes of various metals supplied with the apparatus.

C is a glass vessel with fixed mark etched in glass, up to which water, or other liquid, is placed. The vessel is provided with draw-off cock.

Sole Makers of this Apparatus—

BREWSTER, SMITH, & CO.,

6 CROSS STREET, FINSBURY, E.C.

Manufacturers and Importers of Chemical and Scientific Apparatus and Pure Chemicals.

WEIGHTS a Speciality, 500 Milligrams to 1 Milligram, 12. 6d. per doz.

SEND FOR COMPLETE ILLUSTRATED CATALOGUE.

CARL ZEISS,

MANUFACTURER OF

MICROSCOPES; TELESCOPES (ASTRONOMICAL and TERRESTRIAL); PRISM FIELD GLASSES; TELEMETERS; PHOTOGRAPHIC OBJECTIVES; and OPTICAL MEASURING INSTRUMENTS, including COMPARATORS, REFRACTOMETERS, BUTTER-REFRACTOMETERS, SPECTROMETERS, &c.

LONDON BRANCH:

29 MARGARET ST., CAVENDISH SQUARE, W.

Telegrams:—DIACINIC, London.

CATALOGUES POST FREE. KINDLY SAY WHICH REQUIRED.

Apparatus for estimation of sulphur in spent oxide.

**FREDK. JACKSON & Co.**

(Late MOTTERSHED & CO.),

14 CROSS STREET, MANCHESTER.

Goods Entrance: 10 Half-Moon Street,

LABORATORY FURNISHERS,
Importers, Manufacturers, and Dealers in
CHEMICAL AND PHYSICAL APPARATUS

Of every Description.

Fine Chemicals, Volumetric Solutions,
Plain and Stopped Bottles,

AND EVERY LABORATORY REQUIREMENT.

Illustrated Catalogue of Apparatus, with Price List
of Chemicals, free on application.

Telegraphic Address—"APPARATUS, MANCHESTER."

Telephone Number—2038.

SOLAR AND STELLAR SPECTROSCOPES.

Evershed's Solar Spectroscopes (specially
Designed by J. EVERSHED, F.R.A.S., for the Observation of Solar
Protuberances.)

Disc Prisms, for Use in Front of a Telescope

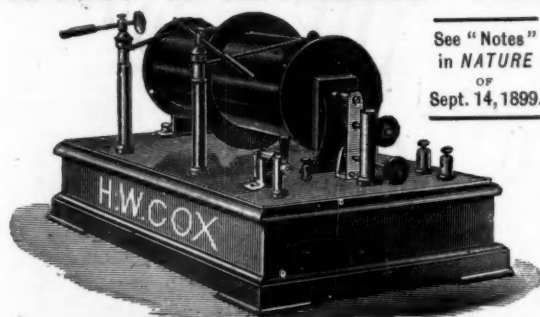
Object-Glass for Stellar Spectroscopy and Eclipse Work.

And all other requirements for Celestial Spectroscopy.

FOR THE ECLIPSE. Film reproductions of
ROWLAND'S Gratings adapted to Hand Telescopes or Binoculars of
any kind, for Observation of the Sun at the Flash Point. The
Spectrum from A to H is more than 20". The Grating is on a Prism,
which is Mounted in a Cap with Eyehole, which can be put on or
taken off in an instant.

PRICE from 35s.

ADAM HILGER, 204 Stanhope St., London, N.W.

X-RAY & ÆTHERIC TELEGRAPHY APPARATUS

See "Notes"
in NATURE
OF
Sept. 14, 1899.

OF THE HIGHEST QUALITY AND FINISH ONLY,
As supplied by us to H.M. Government and the leading
Hospitals and X-Ray Workers throughout the World.

We are the actual Manufacturers, and Guarantee
every Coil against breaking down.

CALL OR WRITE FOR OUR NEW ILLUSTRATED LIST, WITH
TESTIMONIALS AND ILLUSTRATED INSTRUCTIONS UPON HOW
TO WORK. POST FREE TO READERS OF "NATURE."

HARRY W. COX, Ltd.,

10, 11, 28 CURSITOR STREET,
CHANCERY LANE, LONDON.

Radiographs taken for Scientific and Medical Men, and
Demonstrations given.

HARVEY & PEAK

(BY APPOINTMENT TO THE ROYAL INSTITUTION OF GREAT BRITAIN)

HAVE FOR DISPOSAL A NUMBER OF

NICOL PRISMS AND TOURMALINES of various Sizes.

PROJECTION POLARISCOPEs of various Sizes in Stock, with large Nicol Prisms:—

STUDENTS' SPECTROMETERS.—P. O. Bridge Sets, for Schools.—Induction Coils.—Wimshurst Machines.—

X-Ray Apparatus.—Optical Banks, &c., &c.

H. & P. are the actual Manufacturers of the above.

56 CHARING CROSS ROAD, LONDON, W.C.

L. CASELLA,
Scientific Instrument Maker,
Engineer, &c.



THEODOLITES.
LEVELS.
SEXTANTS.
HORIZONS.
COMPASSES.
TELEMETERS.
TIDE GAUGES.
STEAM AND PRESSURE
GAUGES.
ANEROIDS.
&c., &c.

PARTICULARS AND PRICES MAY BE
HAD ON APPLICATION.

WRITE FOR DESCRIPTIVE PAMPHLETS AND CATALOGUES
OF SURVEYING INSTRUMENTS, &c.

147 Holborn Bars,
LONDON, E.C.

Telegraphic Address:—"ESCUTCHEON, LONDON."
Telephone:—No. 1054, HOLBORN.

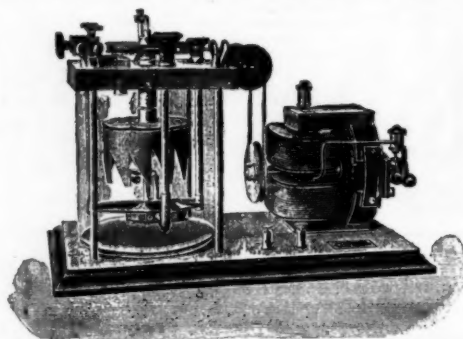
ISENTHAL, POTZLER & CO.,

85 MORTIMER STREET, LONDON, W.

Telegrams: "HYSTERESIS."

Telephone: 2099, GERRARD.

CENTRAL DEPOT for RADIOGRAPHERS.



MERCURY JET INTERRUPTER.

3000-50,000 Interruptions per Second.

Write for Lists, or better inspect our
Installations.

HIGHEST REFERENCES.

EVERYTHING NOVEL & ORIGINAL.

Sole Agents for Scotland:

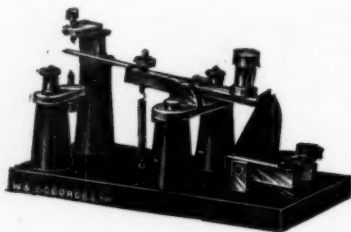
Messrs. JAMES WHITE, Cambridge Street, Glasgow.

"NIVOC" SPECIALITIES.

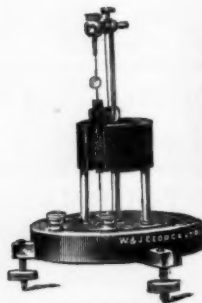
WORKS—BIRMINGHAM.

Buy direct from the Manufacturers.

THESE INSTRUMENTS ARE SPECIALLY
SUITED FOR WORKING TOGETHER.



KEMPE'S CHARGING & DISCHARGING KEY.
Improved Form with rubbing contacts, highly
insulated, £3 15s. Highest quality and finish.



"NIVOC" MOVING COIL GALVANOMETER
BALLISTIC, very sensitive. To work with $\frac{1}{2}$ Micro-
Farad Condenser, £2 10s.



STANDARD CONDENSER, $\frac{1}{2}$ Micro-
Farad, £2 12s. 6d.

STANDARD CLARK CELL, 25s. net.

W. & J. GEORGE, LTD., 33-37 HATTON WALL, LONDON.
(Late F. E. BECKER & CO.)

DUDDELL OSCILLOGRAPH

**An Invaluable Instrument for
Alternate Current Work.**

This Galvanometer has the shortest
periodic time of any Instrument
yet constructed, viz. 0.0001 Second,
is perfectly dead-beat and the self-
induction is practically nil.

Write for Descriptive Pamphlet.

SOLE MAKERS—

**SCIENTIFIC INSTRUMENT CO.
LIMITED,
CAMBRIDGE.**

W. G. PYE & CO.,

"GRANTA" WORKS, MILL LANE, CAMBRIDGE.

MAKERS OF PHYSICAL, PHYSIOLOGICAL, AND OTHER SCIENTIFIC INSTRUMENTS.

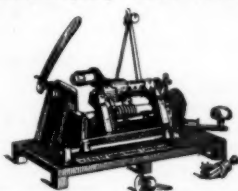
Sole Makers of Leake's Patent

Flat-cutting Rocking Microtome.

Unsurpassed for ordinary work,
unequalled for Botanical work.

Price, as illustrated, in Case,

£6 6 0



LEAKE'S PATENT MICROTOME.

CAMBRIDGE PATTERN Rocking

Microtome, in Case, £3 5s.

Resistance Boxes from £3.

Improved Reflecting Galvanometers,
£3.

School Galvanometers from 10s. 6d.

PYE'S Improved Pattern Boyle's Law Apparatus ... £1 5 0 As shown at the recent Educational Exhibition at South
" " " Constant Volume Air Thermometer 0 15 0 Kensington with the Cambridge University Exhibits.
" " " PRICE LISTS AND PAMPHLETS ON APPLICATION. (ILLUSTRATED CATALOGUE IN PREPARATION.)

NEW SCIENCE LANTERN.

SOLE MAKERS:
**REYNOLDS & BRANSON,
Ltd.**

**IMPROVED
PORTABLE
DESIGN.**



The Universal Science Lantern has been devised for the projection of experiments. In the short box in front of the lantern is a hinged mirror, so placed that by the movement of a stud it may be introduced and placed at an angle of 45 degrees with the parallel beam. The beam is thus sent upwards through a horizontal convergent lens, on which a slide or horizontal piece of apparatus can be placed. Above this is the objective mounted on a brass pillar, and above the objective a prism or mirror (if the screen is elevated above the lantern plain prisms are required for each beam), silvered on the outside so that there is no double reflection. The mirror can be adjusted to any angle, and is intended to send the image in an approximately horizontal direction to the screen. Slides can also be directly projected in the usual way.

The base-board is made to fold so that the lantern can be packed into a box 18½ x 8½ x 2½ with all its accessories *in situ*.

Price Complete, in Travelling Box, £9 0 0

REYNOLDS & BRANSON, LTD.
14 COMMERCIAL STREET, LEEDS.

OBSERVATIONS AND - - - SCIENTIFIC INVESTIGATIONS

Can be performed easily
and quickly, and impor-
tant facts and deductions
neatly and legibly re-
corded, with the aid of a
Writing Machine. The
one that will enable the
Scientist to obtain the
best results, and give
him the greatest satisfac-
tion, is undoubtedly that
Marvel of Mechanical
Skill,



THE
**YÖST
TYPE-
WRITER.**

For full particulars of this wonderful Instrument, send
for Illustrated "E" Catalogue to

The YÖST TYPEWRITER Co., Ltd.,
50 HOLBORN VIADUCT,
London, E.C.

WEST END DEPÖT:—303 Oxford Street.

Now Ready, 8vo, Price 6s. net.

RECENT & COMING ECLIPSES.

BY

SIR NORMAN LOCKYER, K.C.B., F.R.S.

Second Edition, containing an account of the observations made at Viziadrag, in India, in 1898, and of the conditions of the Eclipses visible in 1900, 1901 and 1905.

MACMILLAN AND CO., LTD., LONDON.

LIVING SPECIMENS FOR THE MICROSCOPE.

Volvox, *Spirogyra*, *Desmids*, *Diatoms*, *Amoeba*, *Arcella*, *Actinosphaerium*, *Vorticella*, *Stentor*, *Hydra*, *Floscularia*, *Stephanoceros*, *Melicerata*, and many other Specimens of Pond Life. Price 12. per Tube, Post Free. *Helix pomatia*, *Astacus*, *Amphioxus*, *Rana*, *Anodon*, &c., for Dissection purposes.

THOMAS BOLTON,

25 BALSALL HEATH ROAD, BIRMINGHAM.

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM.

THE LABORATORY, PLYMOUTH.

The following animals can always be supplied, either living or preserved by the best methods:—

Sycon; *Clava*, *Obelia*, *Sertularia*; *Actinia*, *Tealia*, *Caryophyllia*, *Alcyonium*; *Hormiphora* (preserved); *Leptoplana*; *Lineus*, *Amphiporus*; *Nereis*, *Aphrodite*, *Arenicola*, *Lanice*, *Terebella*; *Lepas*, *Balanus*, *Gammarus*, *Ligia*, *Myis*, *Nebalia*, *Carcinus*; *Patella*, *Buccinum*, *Eledone*, *Pecten*, *Bugula*, *Crisis*, *Pedicularia*, *Holothuria*, *Asterias*, *Echinus*; *Ascidia*, *Salpa* (preserved), *Scyllium*, *Rais*, &c., &c.

For prices and more detailed lists apply to Biological Laboratory, Plymouth.

THE DIRECTOR.

THE MOST NUTRITIOUS.

EPPS'S

GRATEFUL—COMFORTING.

C O C O A

BREAKFAST—SUPPER.

THE IRISH NATURALIST.

A Monthly Magazine of Irish Zoology, Botany, and Geology. Price 6d.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD PRAEGER, B.A.

Annual Subscription, 5s. Post Free to any Address.

Dublin: EASON & SON, LTD., 40 Lower Sackville Street (to which Address Subscriptions should be sent).

London: SIMPKIN, MARSHALL, HAMILTON, KENT, & CO., Ltd.

NOTICE.—Advertisements and business letters for NATURE should be addressed to the Publishers; Editorial communications to the Editor. The telegraphic address of NATURE is "PHUSIS," LONDON.

SUBSCRIPTIONS TO "NATURE."

	£	s.	d.
Yearly	1	8	0
Half-yearly	0	14	6
Quarterly	0	7	6
TO ALL PLACES ABROAD:—			
Yearly	1	10	6
Half-yearly	0	15	6
Quarterly	0	8	0

Cheques and Money Orders payable to MACMILLAN & CO., Limited.

OFFICE: ST MARTIN'S STREET, LONDON, W.C.

CO-OPERATIVE WORLD TRAVEL

Organised by HENRY S. LUNN, M.D., F.R.G.S., W. HOLDSWORTH LUNN & CONNOP F.S. PEROWNE.

A Cruise to the CENTRAL MEDITERRANEAN.

(MARSEILLES, PALMA, ALGIERS, MALTA, SICILY, CAPRI, NAPLES, MARSEILLES.)

(Return Ticket to MARSEILLES included.)

AN EIGHTEEN DAYS' CRUISE FOR £21 OS. AND UPWARDS.

s.v. ARGONAUT. Tonnage, 3254; h.-p., 4000.

£10 10s. and £13 13s. TOURS TO ROME.

Extensions to NAPLES, FLORENCE, VENICE, and the ITALIAN LAKES.

Full particulars from the Secretary, 5 Endsleigh Gardens, Euston, London, N.W.

MINERALS, ROCKS, AND PRECIOUS STONES.

Choice Minerals for Museums, Characteristic Examples for the Teacher, Student, or Prospector.

LAPIDARIES' WORK IN ALL BRANCHES.

BLOWPIPE CASES AND APPARATUS.

LESSONS GIVEN.

SAMUEL HENSON,

97 REGENT STREET, LONDON, W.

ESTABLISHED 1840.

PHYSIOGRAPHY and GEOLOGY.

COLLECTIONS & MICROSCOPIC SLIDES,

As advised by Science and Art Directory, arranged by

JAMES R. GREGORY & CO., Mineralogists, &c.

To Science and Art Department, British, Indian and Colonial Museums, &c.

NOVELTIES and RARE GEMS and PRECIOUS STONES.

Mineral Specimens for Museums, and Collectors, and all purposes. Rock Specimens and Microscopic Sections of Rocks and Minerals cut to order.

NEW AND VALUABLE MINERAL SPECIMENS CONSTANTLY ARRIVING.

Stores & Offices: 1 Kelso Place, KENSINGTON, W.

NEW CATALOGUES AND LISTS FREE.

HOLLOWAY'S OINTMENT CURES

Gout, Rheumatism, Lumbago, Sciatica, Cuts, Bruises, Sprains, &c.

INVALUABLE FOR ALL SKIN DISEASES.

Holloway's Ointment and Pills may be obtained of all Medicine Vendors.

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
*Three Lines in Column	0	2	6
Per Line after	0	0	9
One Eighth Page, or Quarter Column	0	18	6
Quarter Page, or Half a Column	1	15	0
Half a Page, or a Column	3	5	0
Whole Page	6	6	0

* The first line being in heavy type is charged for as Two Lines.

MAGMILLAN & CO.'S SCIENCE CLASS BOOKS.

ADAPTED TO THE SOUTH KENSINGTON SYLLABUSES.

I.—PRACTICAL PLANE & SOLID GEOMETRY.

Practical Plane and Solid Geometry. By J. HARRISON, M.Inst.M.E., &c. Instructor in Mechanics and Mathematics, and G. A. BAXANDALL, Assistant Instructor Royal College of Science, London. Part I. ELEMENTARY. 2s. 6d. Part II. ADVANCED. 4s. 6d.

Test Papers in Practical Plane and Solid Geometry. Elementary Stage. By GEORGE GRACE, B.Sc. (Lond.). 24 Tests printed on Cartridge Paper. 2s.

III.—BUILDING CONSTRUCTION.

Building Construction for Beginners. By J. W. RILEY, Rochdale Technical School. 2s. 6d.

V.—MATHEMATICS.

An Elementary Course of Mathematics. Comprising Arithmetic, Algebra, and Euclid. By H. S. HALL, M.A., and F. H. STEVENS, M.A., Masters of the Military Side, Clifton College. 2s. 6d.

Graduated Test Papers in Elementary Mathematics. By WALTER J. WOOD, B.A. 1s.

Practical Mathematics. By F. CASTLE, M.I.M.E. 3s. 6d.

VI.—THEORETICAL MECHANICS.

Mechanics for Beginners. By W. GALLATLY, B.A. 2s. 6d.

Mechanics for Beginners. By Rev. J. B. LOCK, M.A. Part I. Mechanics and Solids. 2s. 6d.

Hydrostatics for Beginners. By F. W. SANDERSON, M.A. 2s. 6d.

VII.—APPLIED MECHANICS.

Lessons in Applied Mechanics. By Prof. J. H. COTTERILL, F.R.S., and J. H. SLADE. 5s. 6d.

VIII.—SOUND, LIGHT, AND HEAT.

Elementary Lessons in Heat, Light, and Sound. By D. E. JONES, B.Sc., Inspector of Science Schools under the Science and Art Department. 2s. 6d.

Heat for Advanced Students. By E. EDSE, A.R.C.Sc. 4s. 6d.

Exercises in Practical Physics for Schools of Science. By Prof. R. A. GREGORY and A. T. SIMMONS, B.Sc. (Lond.). In two parts. 2s. each.

Elementary Physics. By BALFOUR STEWART, F.R.S. New Edition, thoroughly Revised. 4s. 6d. Questions. 2s.

IX.—MAGNETISM AND ELECTRICITY.

Electricity and Magnetism for Beginners. By F. W. SANDERSON, M.A. 2s. 6d.

Magnetism and Electricity for Beginners. By H. E. HADLEY, B.Sc. (Lond.). 2s. 6d.

Elementary Lessons in Electricity and Magnetism. By Prof. SILVANUS P. THOMPSON, F.R.S. New Edition. 4s. 6d.

X. & XI.—CHEMISTRY.

INORGANIC CHEMISTRY—THEORETICAL.

Chemistry for Beginners. By Sir HENRY ROSCOE, F.R.S., assisted by J. LUNT, B.Sc. New Edition, revised. 2s. 6d.

The Elements of Chemistry. By Prof. IRA REMSEN. 2s. 6d.

Inorganic Chemistry for Advanced Students. By Sir H. E. ROSCOE, F.R.S., and Dr. A. HARDEN. 4s. 6d.

X. & XI.—CHEMISTRY—continued.

Chemical Problems. By Prof. T. E. THORPE, F.R.S. With Key. 2s.

Chemical Arithmetic. By S. LUPTON, M.A. With 1200 Problems. 4s. 6d.

Inorganic Chemistry. By Prof. IRA REMSEN. 6s. 6d.

INORGANIC CHEMISTRY—PRACTICAL.

Chemistry for Organised Schools of Science. By S. PARRISH, B.Sc., A.R.C.S. (Lond.), with Introduction by Dr. FORSYTH. 2s. 6d.

Practical Inorganic Chemistry. By G. S. TURPIN, M.A., D.Sc. 2s. 6d.

Practical Inorganic Chemistry for Advanced Students. By CHAPMAN JONES, F.I.C., F.C.S. 2s. 6d.

The Junior Course of Practical Chemistry. By F. JONES, F.C.S. 2s. 6d. The New Edition of this book covers the Syllabus of the South Kensington Examination.

ORGANIC CHEMISTRY—THEORETICAL.

Organic Chemistry for Beginners. By G. S. TURPIN, M.A., D.Sc. 2s. 6d.

Organic Chemistry. By Prof. IRA REMSEN. 6s. 6d.

XII.—GEOLOGY.

Geology for Beginners. By W. W. WATTS, M.A., F.G.S. 2s. 6d.

XIV.—HUMAN PHYSIOLOGY.

Physiology for Beginners. By Sir MICHAEL FOSTER, K.C.B., and Dr. L. E. SHORE. 2s. 6d.

Physiology for Advanced Students. By A. STANLEY KENT, M.A. (Oxon.). [In preparation.]

Lessons in Elementary Physiology. By the Right Hon. T. H. HUXLEY, F.R.S. 4s. 6d. Questions. 1s. 6d.

XVII.—BOTANY.

Botany for Beginners. By ERNEST EVANS, Burnley Technical School. 2s. 6d.

XIX.—METALLURGY.

A Text-Book of Elementary Metallurgy. By A. H. HIORNS, Principal of the School of Metallurgy, Birmingham and Midland Institute. 3s. Questions. 1s.

XXIII.—PHYSIOGRAPHY.

Experimental Science (Section I. Physiography). By Prof. R. A. GREGORY and A. T. SIMMONS, B.Sc. 2s. 6d.

Physiography for Beginners. By A. T. SIMMONS, B.Sc. 2s. 6d.

Physiography for Advanced Students. By A. T. SIMMONS, B.Sc. 4s. 6d.

Elementary Lessons in Astronomy. By Sir NORMAN LOCKYER, K.C.B. New Edition. 5s. 6d. This book contains all the Astronomy required for the Advanced and Honours Stages.

XXIV.—THE PRINCIPLES OF AGRICULTURE.

Agriculture for Beginners. By A. J. COOPER, Harris Institute, Preston. [In preparation.]

Elementary Lessons in the Science of Agricultural Practice. By H. TANNER, F.C.S. 3s. 6d.

XXV.—HYGIENE.

Hygiene for Beginners. By E. S. REYNOLDS, M.D. 2s. 6d.

Handbook of Public Health and Demography. By E. F. WILLOUGHBY, M.B. New and Revised Edition. 4s. 6d.

MACMILLAN AND CO., LIMITED, LONDON.

MACMILLAN & CO.'S NEW SCIENTIFIC BOOKS.

ENLARGED AND REVISED EDITION NOW READY.

LESSONS IN ELEMENTARY PHYSIOLOGY.

BY THOMAS H. HUXLEY, LL.D., F.R.S.

Enlarged and Revised Edition. Globe 8vo. 4s. 8d.

AN ELEMENTARY COURSE OF PRACTICAL ZOOLOGY.

By the late **T. JEFFERY PARKER**, D.Sc., F.R.S., Professor of Biology in the University of Otago, Dunedin, New Zealand, and **W. NEWTON PARKER**, Ph.D., Professor of Zoology at the University College of South Wales and Monmouthshire, in the University of Wales. With 156 Illustrations. Crown 8vo. 10s. 6d.

A MANUAL OF ZOOLOGY.

By the late Prof. **T. J. PARKER**, D.Sc., F.R.S., and Prof. **W. A. HASWELL**, M.A., D.Sc., F.R.S.

With Three Hundred Illustrations. Crown 8vo, 10s. 8d.

KNOWLEDGE.—"The text is accompanied by about three hundred beautiful illustrations. . . . The treatment is explicit throughout, and the book is sure to gain a wide popularity."

FIELD.—"For those who require a manual to assist them in acquiring an accurate knowledge of zoology we know of no book superior to that under notice. . . . The illustrations are admirable. We know of no work better fitted to fulfil the purpose for which it was designed than the one under notice. It is an admirable introductory text-book to scientific zoology."

TEXT-BOOK OF PALÆONTOLOGY.

By **KARL A. VON ZITTEL**,

Professor of Geology and Palæontology in the University of Munich. Translated and Edited by **CHAS. R. EASTMAN**, Ph.D., Assistant in Palæontology in the Museum of Comparative Zoology at Harvard. With 1476 Woodcuts. Medium 8vo. 25s. net.

. *This English Edition is revised and enlarged by the Author and Editor in collaboration with numerous Specialists.*

SPEAKER.—"In this sphere Prof. Zittel's books have long held the field as the standard works of their class, but to many they have been inaccessible on account of their being in a foreign tongue. . . . It has not merely been translated; it has been edited and brought up to date as well. . . . The author and editor have conferred a great boon upon their fellow-workers, whether English or foreign, by bringing out what is really a new edition of this work. . . . A most valuable addition to the scientific literature of the world, and the publication of the second volume, dealing with the Vertebrata, will be awaited with the keenest interest on all sides."

VOL. III. (COMPLETING THE WORK) NOW READY.

DICTIONARY OF POLITICAL ECONOMY. Edited by R. H. INGLIS PALGRAVE.

Vol. III. (completing the work). Medium 8vo, 21s. net. Also ready, Vols. I. and II., 21s. net each.

STATIST.—"Brings to completion an excellent cyclopædia of all matters pertaining to political economy."

DEMOCRACY AND EMPIRE, WITH STUDIES OF THEIR PSYCHO-

LOGICAL, ECONOMIC, AND MORAL FOUNDATIONS. By **FRANKLIN HENRY GIDDINGS**, M.A., Ph.D., Professor in Columbia University, New York. 8vo. 8s. 6d. net.

MONOPOLISTS AND TRUSTS. By RICHARD T. ELY, Ph.D., LL.D., Professor

of Political Economy and Director of the School of Economics, Political Science, and History in the University of Wisconsin. Crown 8vo. 5s. net.

THE PRINCIPLES OF MECHANICS PRESENTED IN A NEW FORM.

By **HEINRICH HERTZ**, late Professor of Physics in the University of Bonn. With an Introduction by **H. VON HELMHOLTZ**. Authorised English Translation by **D. E. JONES**, B.Sc., District Inspector under the Department of Science and Art, &c., and **J. T. WALLEY**, M.A. 8vo. 10s. net.

ENGINEER.—"A very remarkable book. . . . A book which it is impossible to pass over in silence, fraught as it is with infinite possibilities of the future. It represents the latest work of one of the finest intellects of the century."

INTRODUCTION TO PHYSICAL CHEMISTRY. By JAMES WALKER, D.Sc.,

Ph.D., Professor of Chemistry in University College, Dundee. 8vo. 10s. net.

LANCET.—"The book is written in such a lucid way as to render its perusal free from that irksomeness which is so often the student's experience when confronted with theoretical considerations. The book should serve as an admirable introduction to more advanced works."

THE THEORY OF ELECTROLYTIC DISSOCIATION AND SOME OF

ITS APPLICATIONS. By **HARRY C. JONES**, Associate in Physical Chemistry in Johns Hopkins University. Extra crown 8vo. 7s. net.

THE TEACHING OF ELEMENTARY MATHEMATICS. By DAVID EUGENE

SMITH, Principal of the State Normal School at Brockport, New York. Crown 8vo. 4s. 6d. net.

[Teachers' Professional Library.]

THE NATURE AND WORK OF PLANTS. An Introduction to the Study of

Botany. By **DANIEL TREMBLY MACDOUGAL**, Ph.D., Director of the Laboratories, New York Botanical Garden. Crown 8vo. 4s. 6d.

MACMILLAN AND CO., LIMITED, LONDON.

NOTICE.—SPECIAL RE-ISSUE BY NATURE
OF THE
INTERNATIONAL SCIENTIFIC SERIES
FOR A STRICTLY LIMITED PERIOD.
EIGHTY-SIX VOLUMES.

**A COMPLETE LIBRARY OF SCIENCE AT
A GREATLY REDUCED PRICE.**

PUBLISHERS' PRICE	...	...	...	...	£21 10 0
BY INSTALMENT (TO-DAY)	...	...	...	...	£14 14 0
FOR CASH	...	...	...	...	£13 10 0

The "International Scientific Series" has a world-wide reputation, and is to be found in every well-equipped Library throughout the English-speaking world. No more generous or acceptable present could be made to any Public Library or individual than this magnificent Encyclopædia of Scientific Research.

Most of the works are illustrated, and many with beautiful coloured plates. The Series has been contributed to by men of science of the highest eminence, such as Tyndall, Herbert Spencer, Walter Bagehot, Alexander Bain, Stanley Jevons, Huxley, Sir John Lubbock, G. J. Romanes, Balfour Stewart, Sir Norman Lockyer, Draper, Bonney, Sir Hubert Parry, Sir E. Maunde Thompson. This list only professes to convey a slight idea of the attention that has been given to the whole Series by the selection of only the best writers to deal with the various subjects considered.

This special offer is open only for a short time, and intending purchasers will do well therefore to send their orders without delay.

For the benefit of those who do not feel disposed to buy the entire Series, it will be possible to secure half the Series, making 43 volumes, for £7 cash, or £7 7s. on the instalment system, the purchaser himself selecting the volumes. The whole Series or half, as the case may be, will be sent on receipt of the first payment of One Guinea—the rest to be paid at the rate of £1 1s. per month.

NOTE:—This OFFER will be WITHDRAWN almost immediately.

ORDER AT ONCE.

A Set of the Volumes may be seen at the Office of NATURE, ST. MARTIN'S STREET, W.C.

A Pamphlet, giving titles, &c., of the Works in the Series, Specimen Pages, with Illustrations, of some of the Volumes, also Order Form, will be sent Post Free on application to

C. WORSFOLD, "NATURE" Office, St. Martin's Street, London, W.C.

ORDER FORM.

Date.....1900.

All cheques should be crossed and made payable to C. WORSFOLD, "NATURE" Office, St. Martin's Street, W.C.

I enclose One Guinea as first payment for "NATURE's Re-issue of the International Scientific Series," and I agree to pay to you, or your representative, the balance at the rate of One Guinea per month; my next payment to be on delivery of the volumes, and my remaining payments on the corresponding day of each month following.

Until such payments are complete, I engage that the Works, not being my property, shall not be disposed of by sale or otherwise.

I further agree that if it be found impossible for any reason to deliver the books, the return of the sum of One Guinea to me shall cancel this agreement.

Name.....

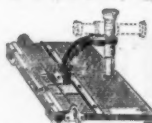
Address.....

Residents abroad are kindly requested to remit in full, or to instruct their representatives in England to make the monthly payments, in order to avoid the expense and delay in forwarding cash from abroad.



HARRIS'S ORIGINAL PATTERN ATWOOD MACHINE, 7012A, Accurate and Reliable, 8 to 9 feet high, Graduated, £3 15s.

HARRIS'S SPECIALITIES.—CATALOGUES UPON APPLICATION.



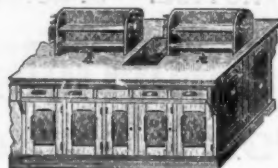
Vernier Microscope, 796A, £2 2s. 6d.



Registered Differential Thermometer, 6287A, 15s. 6d.



New Catheterometer, 787C, £5 1s. 6d.



Complete Laboratory Furnishing.



Drawing Model

ESTIMATES FREE.

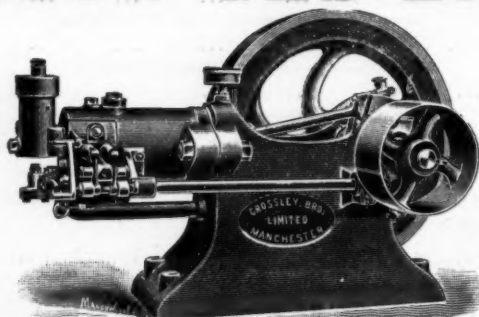
PHILIP HARRIS & Co., LTD.,

Telegraphic Address: "Science," Birmingham. Telephone No. 10.

COMPLETE LABORATORY FURNISHERS, BIRMINGHAM.

CROSSLEY'S GAS ENGINES.

RECENTLY
REMODELLED.



GREAT
REDUCTION
IN
GAS
CONSUMED.

CROSSLEY BROS., LTD., OPENSHAW, MANCHESTER.

WATSON'S NEW MICROSCOPES AND APPARATUS.



WATSON'S HOLOSCOPIC EYEPIECES, for use with either APOCHROMATIC or ACHROMATIC OBJECTIVES, an adjustment being provided to the special lenses employed, for altering the correction. There is no sacrifice of efficiency, the performance being equal to the most expensive Compensating or Huyghenian Oculars.

Magnifying Powers—

6 in. tube length, 5, 7, 10, and 14 diameters.
10 in. " 7, 10, 14, and 20 "

PRICE, in Student's Size and Pattern, either power, 17/6 each.

For Full Particulars see Supplemental List, Post Free.

WATSON'S PARACHROMATIC OIL IMMERSION CONDENSER.

Total aperture, 1'30; aplanatic aperture exceeds 1'25. Undoubtedly the finest Condenser obtainable for high-power work. Optical part only ... £5 0 0

Completely mounted with Iris Diaphragm and Set of Slides ... £6 10 0

WATSON'S "SCHOOL" MICROSCOPE, New Model, complete with 1 in. Objective, in Case ... £3 3 0

WATSON'S "ROYAL" MICROSCOPE. A new model high-class instrument.

WATSON'S "FRAM" MICROSCOPE. A highest-class instrument at a very moderate cost.

BACTERIOLOGICAL APPARATUS. MICROTOMES. Apparatus for FIELD BOTANY and FIELD GEOLOGY. METAMORPHOSES and DISSECTED PREPARATIONS. BOTANICAL and PHYSIOLOGICAL MODELS.

For Particulars of all the above, see Watson's New Supplemental List to Catalogue No. 2, Post Free on application.

Watson's Catalogue (No. 3) is a Classified List representing a Stock of 40,000 first-class Micro-Slides, Post free on application.

W. WATSON & SONS (Established 1837), Opticians to H.M. Government.

313 HIGH HOLBORN, LONDON, W.C. New Branch Now Open: 16 FORREST ROAD, EDINBURGH. And at 78 Swanston Street, Melbourne, Australia. Awarded 39 Gold and other Medals at the principal International Exhibitions of the World.



**DALLMEYER'S
POPULAR
HAND CAMERA.**

PRICE
£7 7s.

Twelve 1-plates in sheaths, instantaneous changing, rack focussing, ever-set shutter with speed regulator, mahogany body covered good leather, and fitted with a **STIGMATIC LENS**, working at *f. 7.5*.

Send for fully Illustrated List of Lenses and Cameras.

J. H. DALLMEYER, Ltd., 25 Newman St., LONDON, W.

Printed by RICHARD CLAY AND SONS, LIMITED, at 7 & 8 Bread Street Hill, Queen Victoria Street, in the City of London and published by MACMILLAN AND CO., LIMITED, at St. Martin's Street, London, W.C., and THE MACMILLAN COMPANY, 66 Fifth Avenue, New York.—THURSDAY, March 22, 1900.

GENERAL LIBRARY,
UNIV. OF MICH.
APR 11 1900



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

No. 1587, VOL. 61]

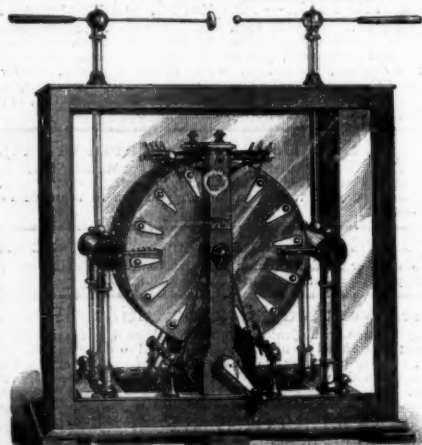
THURSDAY, MARCH 29, 1900.

[PRICE SIXPENCE.

Registered as a Newspaper at the General Post Office.]

[All Rights are Reserved.

WIMSHURST INFLUENCE ELECTRICAL MACHINES.



Multiple-Plate Machine, with 8 Plates, 18 inches, £22.
For X-Ray and Therapeutic work.

NEWTON & CO., Makers, 3 FLEET ST., LONDON.

SHORT BEAM BALANCES.

CHEAP, QUICK-ACTING,
ACCURATE,
KNIFE EDGES AND PLANES OF AGATE
Compensating Stirrup
Suspenders.

To carry 200, 500 grammes.

Price £7. £9 9s.

ASSAY BALANCES.

ALUMINIUM BEAMS.

5 Grammes in each Pan.

Indicate $\frac{1}{10}$ m.g.

£10 10s. and £7.

CHEMICAL BALANCE.

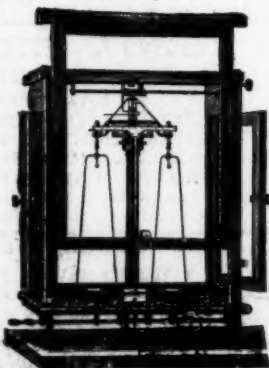
ALUMINIUM BEAM.

New design Sliding Rider.

To carry 100 250 grms.

Indicates $\frac{1}{10}$ m.g.

£8 15s. £10 10s.



WRITE for BALANCE CATALOGUE

JOHN J. GRIFFIN & SONS, ^{LD}
20-26 SARDINIA STREET, LONDON, W.C.

THE FIVE WINDOWS OF THE SOUL. A POPULAR ACCOUNT OF THE HUMAN SENSES. BY EDWARD HAMILTON AITKEN.

Crown 8vo. 6s.

"There is probably nothing in recent literature which will so surely lead to a thirst for further and more technical knowledge than the author's treatment of these difficult subjects. . . . It is admirably written, and cannot fail to give pleasure. It is so seldom that such a really good book as this is published that the hope may be expressed that it will meet with the success it deserves, and find a place in every good public and private library."—*Manchester Guardian*.

COLOUR IN NATURE.

A STUDY IN BIOLOGY.
BY MARION NEWBIGIN.

Crown 8vo 7s. 6d.

"All who seek for well sifted results, and not merely superficial information, will thank her for this book, and congratulate her on a very timely contribution to biological literature."—*Journal of Education*.

JOHN MURRAY, ALBEMARLE STREET, W.

NEGRETTI & ZAMBRA'S



IMPROVED
SELF-RECORDING RAIN-
GAUGES, BAROMETERS &
THERMOMETERS.

Giving continuous Records
on Charts which only require
changing weekly.

Invaluable to Invalids and
others unable to take daily
readings.

Illustrated Price List of Instruments free by Post to all
parts of the World.

NEGRETTI & ZAMBRA,
38 HOLBORN VIADUCT, E.C.

BRANCHES: 45 CORNHILL, and 122 REGENT STREET.

THE LONDON HOSPITAL MEDICAL COLLEGE.

The SUMMER SESSION commences on May 1.

The Hospital is the largest in the kingdom; nearly 800 beds are in constant use, and no beds are closed. Being the only General Hospital for East London—i.e. for a million and a half people—the practice is immense. In-patients last year, 11,622; Out-patients, 178,838; Accidents, 17,370; Major Operations, 230.

APPOINTMENTS.—Owing to the enormous number of patients, more appointments are open to Students than at any other Hospital. Sixty qualified appointments are made annually, and more than 150 Dressers, Clinical Clerks, &c., appointed every three months. All are free to Students of the College. Holders of Resident Appointments have Free Board.

SCHOLARSHIPS AND PRIZES.—Twenty-seven Scholarships and Prizes are given annually. Students entering in May can compete for five Entrance Scholarships in September.

Special arrangements have been made to enable Students entering in May to present themselves for examination in Chemistry, &c., in July.

SPECIAL CLASSES are held for the University of London and other higher Examinations. Special entries for Medical and Surgical Practice can be made. Qualified Practitioners will find excellent opportunities for studying the rarest diseases.

A reduction of 15 Guineas is made to the Sons of Members of the Profession. ENLARGEMENT OF THE COLLEGE.—The new Laboratories and Class-rooms for Bacteriology, Public Health, Operative Surgery, Chemistry, Biology, &c., have now been added, with all modern improvements.

The Club's Union Athletic Ground is within easy reach of the Hospital. The Metropolitan and other Railways have Stations close to the Hospital and College.

For Prospectus and information as to Residence, &c., apply personally, or by letter, to

MUNRO SCOTT, Warden.

Mile End, E.

GLASGOW ROYAL INFIRMARY.

The SUMMER SESSION opens on APRIL 24, 1900. The number of beds, including the Ophthalmic Department, is 612.

Special Wards and Beds are set apart for the treatment of the Diseases of Women, of the Throat and Nose and of the Ear; and there is a specially well-equipped department for the treatment of Diseases and Injury of the Eye. Women Students are admitted to the Clinical Teaching and Practice of the Infirmary; Medical and Surgical Wards being set apart for their exclusive use.

HOUSE APPOINTMENTS.—Five House Physicians and Seven House Surgeons are elected every six months, and an Assistant to the Gynaecologist, who boards but is non-resident, is elected at the same time. Women are eligible for this appointment.

Dressers, Clinical Clerks, and Assistants to the Pathologist are selected from the Students.

BURSARIES.—The David Foulis Scholarship and the John Reid Prize, value £35 each, are open to Students of the Royal Infirmary.

Fees, which include Hospital Practice and the Clinical Lectures—for one year, £10 10s; six months, £6 6s; Three Months, £4 4s. The total fee is £31. Vaccination, £1 1s. Pathology, £4 4s. Bacteriology, £2 2s. For further information apply to

M. THOMAS, M.D., Superintendent.

THE LONDON SCHOOL OF TROPICAL MEDICINE

(UNDER THE AUSPICES OF HER MAJESTY'S GOVERNMENT),
CONNAUGHT ROAD, ALBERT DOCK, E.

IN CONNECTION WITH THE HOSPITALS OF THE SEAMEN'S
HOSPITAL SOCIETY.

The next SESSION commences on TUESDAY, MAY 1, 1900.

For Prospectus, Syllabus, and other particulars, apply to the Secretary, P. MICHELL, Esq., Seamen's Hospital, Greenwich, S.E.; or to Dr. Rees, the Medical Tutor, at the School.

UNIVERSITY COLLEGE, LONDON.

FACULTY OF MEDICINE.

The Summer Session begins on May 1st. The work is arranged so that a Student may advantageously begin his Medical Curriculum then. Full information may be obtained from either of the undersigned.

H. R. SPENCER, M.D., F.R.C.P.,
Dean of the Faculty.
J. M. HORSBURGH, M.A., Secretary.

THE COLLEGE HALL OF RESIDENCE FOR WOMEN STUDENTS.

WYNG PLACE, LONDON, W.C.

The Office of Principal will become vacant at the end of the present Session, and the Council are prepared to receive applications from intending Candidates for the Appointment up to the 15th of May.

For particulars, apply by letter to the HON. SECRETARY at College Hall.

SCIENCE EXAMINATIONS.

For LONDON and other UNIVERSITIES, the
CONJOINT BOARD, &c.

Well-equipped LABORATORIES, DAY AND EVENING. Personal or Class Tuition.

"R," 9 Heathcote Street, Gray's Inn Road, W.C.

BREWOOD GRAMMAR SCHOOL.

HEAD MASTER required, to commence duties in Michaelmas next. He must be a Graduate of some University in the United Kingdom, and Graduates in Arts or Science are invited to apply.

The School, besides the general side, contains an Agricultural side and Farm School, towards which an annual grant is made by the Staffordshire County Council.

Stipend, £200 a year, with capitation fee of £2 per boy. Good residence and boarding house; newly erected Science Laboratory and Class Room.

Applications, together with not more than three testimonials, and the names of three references, to be sent in by April 30th, under cover, to the Clerk, Mr. EDWD. BEETLESTONE, Brewood, near Stafford, from whom further details may be obtained.

By Order,
EDWD. BEETLESTONE,
Clerk to the Governors.

Brewood, Stafford, March 24, 1900.

SCIENCE AND ART EXAMS.

LONDON AND SOUTH KENSINGTON.

Oral or Correspondence Preparation by SPECIALIST TUTORS.

New and Perfected System of Correspondence Tuition. WORKSHEETS
A SPECIALITY, saving Time and Trouble.

ADDRESS:—

JOHN GIBSON, M.A., 24 CHANCERY LANE
W.C.

SCHOLASTIC.—Required, Graduate for
Chemistry and Physics (Practical and Theoretical), Secondary School; salary £150, non-resident. Also for County School, Master for Chemistry, Physics and Geography; qualified to earn Grants from South Kensington; fair salary, non-res. Also for Technical School, Master for Practical Chemistry and Drawing; salary £60, res. Many other Vacancies.—Address, GRIFFITHS, SMITH, POWELL & SMITH, Tutorial Agents, 34 Bedford Street, Strand.

DUMFRIES ACADEMY (School of Art).—

WANTED, an ART MASTER, holding "Art Master's Certificate," to commence duty in September. Salary according to experience, but not exceeding £180 to begin with. Application to be made to the RECTOR.

REQUIRED, Cambridge Nat. Science

Tripos man, or London B.Sc. in Honours, to give tuition in Botany and Zoology.—State terms, &c., to "X," NATURE Office.

Partner Wanted in a Scientific Manufac-

turing Business, with £1000 or upwards. Would suit Scientific Man or Son; exceptional opening; Capital wanted to carry out the Orders open, and—by enlarging Business—to avail of greatly increased trade waiting. Profits very large.—Address, "Scientific," care of NATURE Office.

FLAT SKELETONS OF SMALL ANI-

MALS AND BIRDS, made and mounted in Glass-topped Boxes, by Miss T. SMITTE, Stapden Mount, Arnside, Westmoreland. Prices on application.

INDEXING BY B.A. (CAMB.) 8d. PER

Hour, or "by Piece." Testimonials. "S. V. J.," 293 Uxbridge Road, W.

PHŒNIX FIRE OFFICE,

9 LOMBARD ST., E.C., and 57 CHARING CROSS, S.W.

ESTABLISHED 1782.

MODERATE RATES. ABSOLUTE SECURITY.

ELECTRIC LIGHTING RULES SUPPLIED.

LIBERAL LOSS SETTLEMENTS.

PROMPT PAYMENT OF CLAIMS.

FRANCIS B. MACDONALD, SECRETARY.

LOSSES PAID OVER £22,000,000.

ESTABLISHED 1861.

BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

INVESTED FUNDS

£10,000,000.

The BIRKBECK ALMANACK, with full particulars, post free.

FRANCIS RAVENSCROFT, Manager

BARGAINS IN SCIENTIFIC BOOKS.

BEDDARD, M.A. (FRANK E.), ANIMAL COLORATION. An Account of the Principal Facts and Theories relating to the Colours and Markings of Animals. With 4 Coloured Plates and Woodcuts in the Text, Demy 8vo, Cloth (6s.). 2s. 9d.

BATESON (W.), MATERIAL FOR THE STUDY OF VARIATION, treated with especial regard to Discontinuity in the Origin of Species. By WILLIAM BATESON, M.A., Fellow of St. John's College, Cambridge. 8vo, Cloth (pub. 21s. net). 5s.

"The whole work must be carefully read by every serious student; and there can be no question of its great and permanent value as a contribution to our knowledge of a particular class of variations, and as a stimulus to further work in a department of knowledge which is too much neglected."—*Nature*.

COLE, F.R.M.S. (A. C.), THE METHODS OF MICROSCOPICAL RESEARCH. A PRACTICAL GUIDE TO MICROSCOPICAL MANIPULATION. Second Edition, much enlarged, 8vo, Cloth (6s.). 1s. 6d.

GORE, F.R.A.S., M.R.I.A., &c. (J. E.), THE WORLDS OF SPACE. A Series of Popular Articles on Astronomical Subjects. Illustrations, Crown 8vo, Cloth (pub. 7s. 6d.). 1s. 6d.

SANDFORD (E.), A MANUAL OF EXOTIC FERNS AND SELAGINELLA. Comprising descriptions of over 1000 Species and Varieties, and upwards of 600 Synonyms, also Notes on their History, Culture and Management. Crown 8vo, Cloth (6s. 6d.). 1s. 3d.

BRITTEN, F.L.S. (JAMES), EUROPEAN FERNS, THEIR FORM, HABIT AND CULTURE, with 30 Facsimile Coloured Plates, Painted from Nature, by D. BLAIR, F.L.S., Demy 4to, Cloth (21s.). 7s.

NEWMAN, F.Z.S. (EDWARD), BRITISH BUTTERFLIES AND MOTHS. Illustrated with nearly 900 Life-size Figures of Species of Butterflies and Moths. Super Royal 8vo, Cloth, Gilt Edges (25s.). 12s.

Postage 4d. extra on one, or 6d. on two.

H. J. GLAISHER, New and Remainder Bookseller,
57 WIGMORE STREET, LONDON, W.

Catalogues Post Free on application.

WATKINS & DONCASTER,

NATURALISTS,

AND MANUFACTURERS OF

CABINETS AND APPARATUS

FOR ENTOMOLOGY, BIRDS' EGGS, AND ALL BRANCHES OF
NATURAL HISTORY.

SPECIAL SHOW-ROOM FOR CABINETS.

Call or send for detailed Catalogue (66 pp.), Post free on application.

N.B.—For Excellence and Superiority of Cabinets and Apparatus, references are permitted to distinguished patrons, Museums, Colleges, &c.

A LARGE STOCK OF INSECTS AND BIRDS' EGGS.

Birds, Mammals, &c., Preserved and Mounted by First-class Workmen with true natural surroundings. All Books and Publications on Natural History supplied.

36 STRAND, LONDON, W.C.

(Five Doors from Charing Cross.)

PHYSIOGRAPHY and GEOLOGY.**COLLECTIONS & MICROSCOPIC SLIDES,**

As advised by Science and Art Directory, arranged by

JAMES R. GREGORY & CO.,

Mineralogists, &c.

To Science and Art Department, British, Indian and Colonial
Museums, &c.

NOVELTIES and RARE GEMS and PRECIOUS STONES.

Mineral Specimens for Museums, and Collectors, and all purposes.
Rock Specimens and Microscopic Sections of Rocks and Minerals
cut to order.

NEW AND VALUABLE MINERAL SPECIMENS CONSTANTLY
ARRIVING.

Stores & Offices: 1 Kelso Place, KENSINGTON, W.

NEW CATALOGUES AND LISTS FREE.

**THE SCIENTIFIC ROLL
AND MAGAZINE OF SYSTEMATIZED NOTES.**

THIS WORK IS A VALUABLE
GUIDE, BIBLIOGRAPHY, AND INDEX TO SCIENCE.

In preparation.

BACTERIA (Botanical Section).

Although these are the simplest of plants, there is probably no group of organisms which exceeds them in interest or importance. Their operations affect the welfare of every member of the community, as also of the whole organic world. A full knowledge of them is essential in all questions bearing upon public and private health, agriculture, the microbial diseases of animals and of plants; and it is important in many industries, such as those dealing with milk, butter, hay, flax, tobacco, and others.

The group will be dealt with in three octavo volumes of about 500 pp. each. The subscription price will be 10s. for each volume, payable on delivery of the first number of the volume; or arrangements may be made to supply only the portions relating to a particular species, genus, or topic, at a proportionately reduced rate. The first volume will be commenced next summer, and if sufficient subscribers support the work, the three volumes will be completed in three years. As all the matter will be systematized, the series will be equivalent to a good bacteriological library, with the advantage that the information on any particular point will be comprised within a comparatively few pages, and not scattered over thousands of pages in a host of journals and books.

The names and addresses of subscribers, and applications for prospectus may be sent to the undersigned.

The undersigned will be glad to hear from PRINTERS willing to give estimates for printing, and from PUBLISHERS willing to consider terms for publishing the above-mentioned work.

A. RAMSAY,

4 Cowper Road, Acton, London, W.

Now Ready. 8vo. Price 4s. net.

INORGANIC EVOLUTION

AS STUDIED BY

SPECTRUM ANALYSIS.

BY

SIR NORMAN LOCKYER, K.C.B., F.R.S.

MACMILLAN AND CO., LTD., LONDON.

MINERALS, ROCKS & FOSSILS.

COLLECTIONS FOR STUDENTS.

Carefully labelled and arranged in Boxes with Card Trays.

50 Minerals, 12/6; 100 do., 21/-; 200 do., 42/-.

Rocks and Fossils at similar prices.

300 Minerals in Cabinet, £4 4s.; 400 do., £5 12s. 6d.

Catalogues Post Free.

THOMAS D. RUSSELL,

78 NEWGATE STREET, LONDON, E.C.

TO SCIENCE LECTURERS.

HUGHES' MOTO-PHOTOSCOPE FOR LIVING PICTURES.

THE MOST PERFECT.

No SHUTTER, therefore no Flickering. Superb Mechanism.

The Moto-Photo Camera for taking the Pictures. Illustrated Lists, 2d. See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN, &c. Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great success. New Oxyhydrogen Microscope. Science Lanterns for Class Demonstration. Magnificent Results. Docwra Triple, Prize Medals. Highest Award. Supplied to the Royal Polytechnic Institution, Dr. H. GRATTAN GUINNESS, Madame ADELINA PATTI, &c., &c. Patent Pamphongo, Science Lanterns. The Universal Lantern 4-inch Condensers, 4-wick Lamp, Portrait Combination front Lenses, 18s. 6d., Marvellous value. Science Lecture Sets. Novelties. The Lantern Kaleidoscope. Cheapest Lantern Outfits in the World. Grandly Illustrated Catalogue, over 180 choice Engravings, 6d.; Postage, 3d. List of 300 Lecture Sets, Science Subjects, Views, &c., 6d.; Postage 2d. Pamphlets Free. W. C. HUGHES, SPECIALIST, Brewster House, 82 Mortimer Road, Kingsland, N.

A NEW STEREOSCOPIC BINOCULAR
FIELD GLASS
Of NEW FORM and CONSTRUCTION.

(English Patents, Nos. 5639 and 7942, 1894.)



Of handy size, with large field, brilliant definition, perfect achromatism, and very decided STEREOSCOPIC effect, and which, when once adjusted, are always ready for use.

Prices: £6 to £8.

For NAVAL MEN and DEERSTALKERS, &c. (we have made larger sizes for NIGHT and DAY USE, admitting more light, but of somewhat greater weight). Prices: Night, £10; Day, £11.

Illustrated Price List free.

CARL ZEISS (of JENA),

29 MARGARET STREET, REGENT STREET, LONDON, W.

JAS. SWIFT & SON,

MANUFACTURING OPTICIANS.



SOLELY APPOINTED TO THE A.M. DEPT.
WAR OFFICE, FOR THE SUPPLY
OF MICROSCOPES.

Patent form of Student's Microscope, fitted with $\frac{2}{3}$ " and $\frac{1}{6}$ " Pan-Aplanatic Objectives, Iris Diaphragm and Oculars, in Case, from

£5 5s.

These Instruments, we have supplied in numbers to the following Medical Schools, viz. St. Mary's, St. Bartholomew's, Guy's, Middlesex, London, and St. Thomas's.

Seven Gold Medals awarded for excellence of manufacture.

Catalogue on Application.

81 TOTTENHAM COURT ROAD, W.



C. BAKER,
MICROSCOPE
MANUFACTURER,
1889-1900.

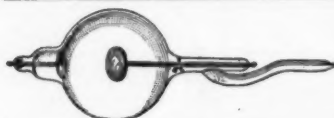
CATALOGUE Post Free to readers
of this Journal. Apply—
244 HIGH HOLBORN, W.C.

EVERETT & CO.,
MECHANICAL ENGINEERS & ELECTRICIANS,
22 CHARTERHOUSE SQUARE, E.C.
MAKERS OF HIGH-GRADE
PHYSICAL & ELECTRICAL APPARATUS.

Apparatus designed and made for Laboratories and Research Work.
ALL KINDS OF EXPERIMENTAL WORK.

Our List is now ready, and may be had post free on application.

See "Notes" in NATURE, March 15, 1900.



COSSOR,
67
FARRINGTON RD.,
E.C.

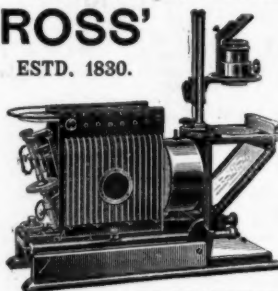
Original Maker of "X" RAY TUBES in England.

FOCUS TUBES giving finest possible definition. IMPROVED TUBE HOLDERS, with arrangement for securing wires to avoid perforation of tube. All kinds of "X" Ray Apparatus, Mercury Pumps, Screens, Spark Gaps, &c. Applications for Price Lists invited.

Medals and Highest Awards at all Great Exhibitions.

ROSS'

ESTD. 1830.



**ROSS' PATENT
NEW MODEL**

**PRISMATIC
BINOCULAR GLASS.**

"The power and field of a Telescope in the compass of an Opera Glass."

Combining Extreme Portability with High Power, Perfect Mechanical Construction, and Exquisite Definition.

NEW SERIES
SCIENCE LANTERNS

FOR SCHOOLS,
COLLEGES, & PRIVATE
EXHIBITIONS.

**PHOTOGRAPHIC LENSES
AND CAMERAS.**

**MICROSCOPES,
TELESCOPES, FIELD
GLASSES, &c., &c.**



	Magnification.	Binocular.
with High Power, Perfect Mechanical Construction, and Exquisite Definition.	6 times ...	... £8 0 0
	8 " ...	... 8 0 0
	10 " ...	... 10 0 0
	12 " ...	... 10 0 0

ROSS, Ltd., Manufacturing Opticians,

111 NEW BOND STREET, LONDON, W.,
And 31 COCKSPUR STREET, CHARING CROSS, S.W.

**IMPROVED D'ARSONVAL
GALVANOMETERS.**

PRICES
£10-0-0
AND
£4-10-0

LIBERAL DISCOUNTS.

Most
SENSITIVE
for
DEFLECTIVE,
ZERO,
or
BALLISTIC
WORK.



Write for Price List and Particulars of Potentiometers, Galvanometers, Electrical Thermometers, Experimental Direct and Alternating Current Sets, &c., to

CROMPTON & CO., LD.,
Laboratory { "THRIPLANDS," } LONDON, W.
KENSINGTON COURT,

DUDELL OSCILLOGRAPH

For Photography, Unsurpassed for fine definition.

COOKE LENSES

TAYLOR, TAYLOR, & HOBSON,
Stoughton Street Works, Leicester;
and 18 Berners Street, London, W.

LETCHER & SONS (formerly Letcher Bros.),
SCIENTIFIC INSTRUMENT MAKERS,
25 TURNPIKE LANE, HORNSEY, N.

BLOWPIPE CABINETS. SPECIALITY: SOCIETY OF ARTS SETS.
PRICE LIST, POST FREE, ON APPLICATION.

E. LEYBOLD'S NACHFOLGER,
SCIENTIFIC INSTRUMENT
MAKERS,
COLOGNE (GERMANY).



New Catalogue of Physical Apparatus,
containing 3400 numbers and 1200 illustrations,
sent on application.

**An Invaluable Instrument for
Alternate Current Work.**

This Galvanometer has the shortest
periodic time of any Instrument
yet constructed, viz. 0.0001 Second,
is perfectly dead-beat and the self-
induction is practically nil.

Write for Descriptive Pamphlet.

SOLE MAKERS—

**SCIENTIFIC INSTRUMENT CO.
LIMITED,
CAMBRIDGE.**

W. WILSON,

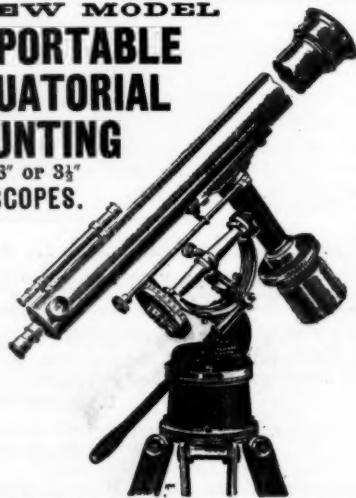
Makers of

SPECTROSCOPES, SPECTROMETERS,
GONIOMETERS,
OPTICAL BENCHES, OPTICAL AND OTHER
MEASURING INSTRUMENTS.
BEST WORK. MODERATE PRICES.

Price List Free.

1, BELMONT STREET, CHALK FARM, N.W.

**NEW MODEL
PORTABLE
EQUATORIAL
MOUNTING**
For 3" or 3½"
TELESCOPES.



Latitude Adjustment, Clamp for Declination Axis, Quick and Slow Motion, in Right Ascension.

EQUATORIAL MOUNTING with Divided Circles and Stand
fitted with short Iron Column, Levelling Screws, and Metal
Stretcher, £15 15s.; or, complete with 3" Telescope, £25.

ILLUSTRATED CATALOGUE GRATIS.

J. H. STEWARD,
OPTICIAN,
406 STRAND, 457 WEST STRAND,
7 GRACECHURCH STREET, LONDON.

**FINAL NOTICE RESPECTING THE
SPECIAL RE-ISSUE BY NATURE
OF THE
INTERNATIONAL SCIENTIFIC SERIES.**

EIGHTY-SIX VOLUMES.

**A COMPLETE LIBRARY OF SCIENCE AT
A GREATLY REDUCED PRICE.**

PUBLISHERS' PRICE	...	...	...	...	£21	10	0
BY INSTALMENT (TO-DAY)	...	...	...	...	£14	14	0
FOR CASH	...	...	...	...	£13	10	0

The "International Scientific Series" has a world-wide reputation, and is to be found in every well-equipped Library throughout the English-speaking world. No more generous or acceptable present could be made to any Public Library or individual than this magnificent Encyclopædia of Scientific Research.

Most of the works are illustrated, and many with beautiful coloured plates. The Series has been contributed to by men of science of the highest eminence, such as Tyndall, Herbert Spencer, Walter Bagehot, Alexander Bain, Stanley Jevons, Huxley, Sir John Lubbock, G. J. Romanes, Balfour Stewart, Sir Norman Lockyer, Draper, Bonney, Sir Hubert Parry, Sir E. Maunde Thompson. This list only professes to convey a slight idea of the attention that has been given to the whole Series by the selection of only the best writers to deal with the various subjects considered.

For the benefit of those who do not feel disposed to buy the entire Series, it will be possible to secure half the Series, making 43 volumes, for £7 cash, or £7 7s. on the instalment system, the purchaser himself selecting the volumes. The whole Series or half, as the case may be, will be sent on receipt of the first payment of One Guinea—the rest to be paid at the rate of £1 1s. per month.

NOTE:—As this OFFER is about to be WITHDRAWN, Orders at present prices must be sent AT ONCE.

A Set of the Volumes may be seen at the Office of NATURE, ST. MARTIN'S STREET, W.C.

A Pamphlet, giving titles, &c., of the Works in the Series, Specimen Pages, with Illustrations, of some of the Volumes, also Order Form, will be sent Post Free on application to

C. WORSFOLD, "NATURE" Office, St. Martin's Street, London, W.C.

ORDER FORM.

Date.....1900.

All cheques should be crossed and made payable to C. WORSFOLD, "NATURE" Office, St. Martin's Street, W.C.

I enclose One Guinea as first payment for "NATURE's Re-issue of the International Scientific Series," and I agree to pay to you, or your representative, the balance at the rate of One Guinea per month; my next payment to be on delivery of the volumes, and my remaining payments on the corresponding day of each month following.

Until such payments are complete, I engage that the Works, not being my property, shall not be disposed of by sale or otherwise.

I further agree that if it be found impossible for any reason to deliver the books, the return of the sum of One Guinea to me shall cancel this agreement.

Name.....

Address.....

Residents abroad are kindly requested to remit in full, or to instruct their representatives in England to make the monthly payments, in order to avoid the expense and delay in forwarding cash from abroad.

LIVING SPECIMENS FOR THE MICROSCOPE.

Volvox, Spirogyra, Desmids, Diatoms, Amœba, Arcella, Actinosphaerium, Vorticella, Stentor, Hydra, Floscularia, Stephanoceros, Melicerta, and many other Specimens of Pond Life. Price 1s. per Tube, Post Free. Helix omatia, Astacus, Amphioxus, Rana, Anodon, &c., for Dissection purposes.

THOMAS BOLTON,

25 BALSALL HEATH ROAD, BIRMINGHAM.

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM.

THE LABORATORY, PLYMOUTH.

The following animals can always be supplied, either living or preserved by the best methods:—

Sycon; Clava, Obelia, Sertularia; Actinia, Tealia, Caryophyllia, Alcyonium; Hornimphora (preserved); Leptoplana; Lineus, Amphiporus; Nereis, Aphrodite, Arenicola, Lanice, Terebella; Lepas, Balanus, Gammarus, Ligia Mysis, Nebalia, Carcinus; Patella, Buccinum, Eledone, Pecten, Bugula, Crisia, Pedicellina, Holothuria, Asterias, Echinus; Ascidia, Salpa (preserved), Scyllium, Raia, &c., &c.

For prices and more detailed lists apply to Biological Laboratory, Plymouth.

THE DIRECTOR.

HOLLOWAY'S PILLS CURE

Biliousness, Sick Headache, Indigestion, and all Internal Complaints.

CAN BE TAKEN BY THE MOST DELICATE.

Holloway's Pills and Ointment may be obtained of all Medicine Vendors.

CO-OPERATIVE WORLD TRAVEL

Organised by HENRY S. LUNN, M.D., F.R.G.S., W. HOLDSWORTH LUNN & CONNOP F.S. PEROWNE.

A Cruise to the CENTRAL MEDITERRANEAN.

(MARSEILLES, PALMA, ALGIERS, MALTA, SICILY, CAPRI NAPLES, MARSEILLES.)

(Return Ticket to MARSEILLES included.)

AN EIGHTEEN DAYS' CRUISE FOR £21 0s. AND UPWARDS.

S.V. ARGONAUT. Tonnage, 3254; h.-p., 4000.

£10 10s. and £13 13s. TOURS TO ROME.

Extensions to NAPLES, FLORENCE, VENICE, and the ITALIAN LAKES.

Full particulars from the Secretary, 5 Endsleigh Gardens, Euston, London, N.W.

THE MOST NUTRITIOUS.

E P P S'S

GRATEFUL—COMFORTING.

C O C O A

BREAKFAST—SUPPER.

ALBERT EDWARD JAMRACH

(Late CHARLES JAMRACH),

NATURALIST,

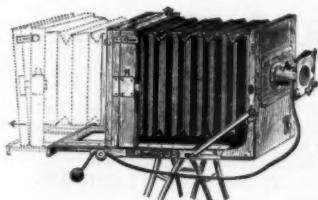
180 ST. GEORGE STREET EAST.

Implements of Savage Warfare, Idols, Sacred Masks, Peruvian Pottery Netsukis China, Lacquers, Gongs, Shells, and other Curios.

TRADE
MARK

"OPTIMUS."

TELEGRAPHIC
ADDRESS.



PHOTOGRAPHIC APPARATUS

OF BEST WORKMANSHIP
FOR ALL PURPOSES.



Catalogue POST FREE.

PERKEN, SON & CO., LTD., 99, HATTON GARDEN, LONDON. HOLBORN CIRCUS, E.C.

APRIL NUMBER NOW READY.

THE SCHOOL WORLD.

A MONTHLY MAGAZINE OF EDUCATIONAL WORK AND PROGRESS. PRICE SIXPENCE.

Annual Subscription, including postage, 8s. net.

CONTENTS.

The Board of Education—Its Work and Relations with the Chief Grades of Secondary Schools: INSPECTION AND REGISTRATION. By Rev. T. W. Sharpe, C.B., M.A.; THE GREAT PUBLIC SCHOOLS. By Rev. H. W. Moss, M.A.; GRAMMAR AND PROPRIETARY SCHOOLS. By Dr. R. P. Scott, M.A.; TECHNICAL INSTRUCTION COMMITTEES. By William Hewitt, B.Sc.; PRIVATE SCHOOLS. By Rev. J. O. Bevan, M.A., F.S.A.; HIGHER GRADE SCHOOLS. By William Dyche, B.A.—**The Study of "As You Like It."** I.: General Conception of the Play. By J. A. Nicklin, B.A.—**On the Use of the Voice in Teaching.** By Patrick Kirwan.—Experimental Chemistry. (Illustrated.) III.: Composition of Water; Hydrogen; Natural Waters; Distillation; Solution. By Prof. J. B. Coleman, A.R.C.S., F.I.C.—**Pioneers in Education.** IV.: Rousseau as an Unpractical and as a Practical Educationist. By Prof. Foster Watson, M.A.—Teachers' Notes on English History, 1603-1715. V.: The Sons of Charles I., 1660-1688. By C. S. Fearenside, M.A., and L. J. McNair, B.A.—**Manual Instruction in Secondary Schools.** By W. A. Knight.—The Board of Education Act, 1899.—Commercial Education in France.—The School Pulpit. War and Righteousness. By Rev. H. W. Moss, M.A.—Items of Interest. General; Welsh; Scottish; Irish; From Abroad; Current History.—**Dr. Leaf's "Iliad."** (Illustrated.)—Reviews of Recent School Books.—London Matriculation, June, 1900. Monthly Test Papers, No. 4.—Junior Oxford Local Examination, July, 1900. Monthly Test Papers, No. 4.—Correspondence: **Use of the Lantern in Teaching.** By Prof. W. C. F. Anderson, M.A. Alternative Course in English Grammar. By J. C. Nesfield, M.A., and Your Reviewer.—Our Chess Column.—Calendar.

MACMILLAN AND CO., LIMITED, LONDON.

..The.. 'N. & G.' Cameras

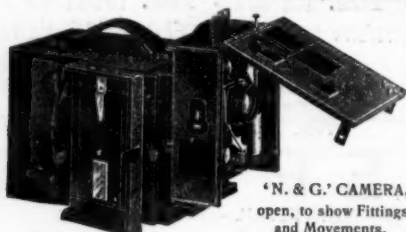
In all sizes up to 7 x 5 in.
For Plates, Cut Films, or Film
in Spools.

For Hand and Tripod.

A Series of High-Class Instruments for Serious Work,
embodying every New Advance in Photography.

Prices from £13 to £50.

Have been in Constant Use for Eight Years in all parts of the World.



'N. & G.' CAMERA,
open, to show Fittings
and Movements.

TRIPOD CAMERAS, SURVEYING CAMERAS, and very Small and
Light POCKET CAMERAS for Travellers and Field Naturalists.

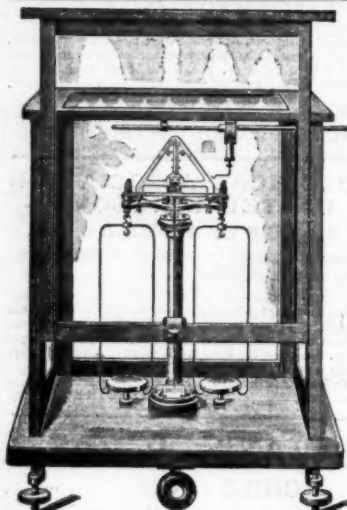
Speciality: COMPLETE OUTFITS for Scientific Expedi-
tions and Special Research.

Catalogues and Estimates of Lenses, Kinematographs, Lanterns, and all
free on application. Photographic Accessories and Materials.

Newman & Guardia, Ltd.

90 & 92 Shaftesbury Avenue, London, W.

SHORT BEAM CHEMICAL BALANCE.



Short Beam
Chemical Balance
for a charge up to
100 grammes in each
Pan, sensible to
1/10th part of a
milligramme. In
Mahogany Glass
Case, with
Solid Marble Base,
Counterpoised
Sliding Front and
Side Doors, Alu-
minium Beam,
divided from the
centre in 1/10th of a
milligramme.
Rider Apparatus.
All Knife Edges
are of Agate
working on Agate
Planes. Automatic
Arrestment for
arrest of Pans and
Beam.
Pans 7 cm. diameter.
Level and
Levelling Screws.
£7 7 0

List of BALANCES
Post Free.

Illustrated Lists of Chemical and Physical Apparatus also
on application.

C. E. MÜLLER & CO.,
SCIENTIFIC GLASS BLOWERS
AND MANUFACTURERS OF
CHEMICAL AND PHYSICAL APPARATUS.
148 High Holborn, London, W.C.

OPPOSITE THE BRITISH MUSEUM.

THACKERAY HOTEL

(TEMPERANCE).

GREAT RUSSELL STREET, LONDON.

THIS newly-erected and commodious Hotel will, it is believed, meet the requirements of those who desire all the conveniences and advantages of the larger modern licensed hotels at moderate charges. Passenger Lift. Electric Light in all Rooms. Bath-rooms on every Floor. Spacious Dining, Drawing, Writing, Reading, and Smoking Rooms. All Floors Fireproof. Perfect Sanitation. Night Porter. Telephone. Bedrooms from 2s. 6d. to 4s. 6d. per night. Full Tariff and Testimonials on application.

Telegraphic Address: "THACKERAY, LONDON."

Proprietor—J. TRUSLOVE.

Also, amalgamated with, and under the same management,

ESMOND HOTEL

(TEMPERANCE).

MONTAGUE STREET, RUSSELL SQUARE.

THIS Hotel, which has been carried on so successfully for the last 13 years, adjoins the British Museum, and is exception-
ally quiet. Bedrooms from 2s. to 3s. 6d. per night. Full Tariff and Testimonials on application.

Telegraphic Address: "TRUSLOVE, LONDON."

Proprietor—J. TRUSLOVE.

TO SCIENTIFIC MEN, NATURALISTS, TRAVELLERS, AND OTHERS.

THE STEREOSCOPIC COMPANY

CAN SPECIALLY
RECOMMEND ANY OF
THE FOLLOWING
HAND CAMERAS.



ADDRESS—
106 & 108 REGENT ST., W.,
and 4 Cheapside, E.C.

THE TWIN-LENS ARTIST,

with full size Focussing-
Finder, Rapid Euryscope
Lenses, Time and Instanta-
neous Shutter, Rising Front,
Focussing Adjustment,
Double Dark Slides,
Magazine or Cartridge
Roll Holders.

1-p. complete, with £ s.
3 Slides ... 14 14
5 x 4 complete,
with 3 Slides 16 16
1-p. complete, with
3 Slides ... 21 0

THE TWIN-LENS ARTIST,

with
MAGAZINE
for 12 Plates or
24 Films,
&c., &c.,
as described.

1-p. complete... £ s.
5 x 4 " ... 17 17
1-p. " ... 22 8

THE TWIN-LENS CARLTON,

Carrying 12 Plates
or Films,
and now so well known
as not to
need description.

PRICE: £ s.
1-p. complete ... 12 12
5 x 4 " ... 15 15
1-p. " ... 21 0

PLEASE READ

Extract of Letter from
R. BOWDLER SHARPE,
Esq., LL.D.,
Assist. Keeper Zoological
Dept., British Museum,
March 4, 1898:—

"I consider it one of the
best day's work I ever did
when I bought one of your
Cameras. The ease with
which it is worked, and the
excellent results obtained,
make it a most pleasurable
accompaniment of a summer's
outing."

FREE LESSONS TO
PURCHASERS.



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 1588, VOL. 61]

THURSDAY, APRIL 5, 1900.

[PRICE SIXPENCE.

Registered as a Newspaper at the General Post Office.]

[All Rights are Reserved.

SCOUTING AND OUTPOST TELESCOPE,

AS SUPPLIED TO THE WAR DEPARTMENT FOR
THE OFFICERS AT THE FRONT.



Magnifying 25 diameters, 42/-.

Also in ALUMINIUM, very light. Larger sizes up to
£5 : 15 : 6, magnifying 35 diameters.

FIELD GLASSES IN CASE,
40/-, 45/-, 90/-, 100/-.

NEWTON & CO.,
3 FLEET STREET, LONDON.

CATALOGUE, POST FREE.

BECK'S NEW MICROSCOPE THE "BRITISH STUDENTS."

Microscope Stand No. 55, as
figured, with Iris Diaphragm,
One Eye-piece; Double Nose-
piece, Two Object-glasses, 2/8"
and 1/6", adjusted to be in
about focus, and the whole
packed in polished Mahogany
Case,

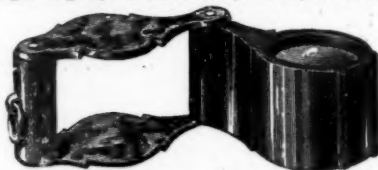
£6 : 8 : 6



No. 55.

R. & J. BECK, Ltd.,
68 CORNHILL, LONDON, E.C.

BROWNING'S PLATYSCOPIC LENS. With Larger Angles, Increased Field, and Improved Definition.



Engraved Real Siat.

AN ACHROMATIC COMBINATION,
COMBINING THE DEFINITION OF A MICROSCOPE WITH THE
PORTABILITY OF A POCKET LENS.

"If you carry a small Platyscopic Pocket Lens (which every observer of
Nature ought to do)."—GRANT ALLEN in *Knowledge*.

The Platyscopic Lens is invaluable to botanists, mineralogists, or ento-
mologists, as it focuses about three times as far from the object as the
Coddington Lenses. This allows opaque objects to be examined easily.

The Platyscopic Lens is made of four degrees of power, magnifying
respectively 10, 15, 20, and 30 diams.; the lowest power, having the largest
field, is the best adapted for general use.

The Lenses are set in Ebonite Cells, and mounted in Tortoiseshell Frames.
Price of the Platyscopic Lens, mounted in Tortoiseshell, magnifying either
10, 15, 20, or 30 diameters, each power, 15s.

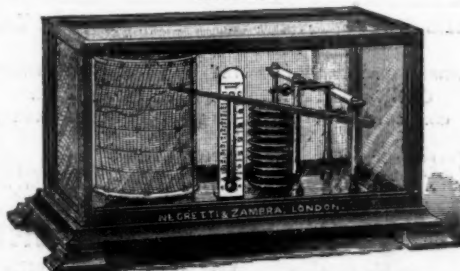
In nickelized German Silver, each power, 17s. 6d.

Illustrated Description sent free.

JOHN BROWNING, 63 STRAND, LONDON, W.C.

NEGRETTI & ZAMBRA'S Self-Registering Barometers, Thermometers and Rain Gauges.

Giving continuous Records on Charts, and only requiring attention
once a week.



THE LARGE SIZE BAROGRAPH, £7 10 0

Accurate Thermometers for all purposes.
Illustrated Price List of Instruments free by post to all
parts of the World.

38 HOLBORN VIADUCT, E.C.

BRANCHES—45 CORNHILL, and 122 REGENT STREET.

GUY'S HOSPITAL MEDICAL SCHOOL.

The SUMMER SESSION will begin on May 1, and Students then entering will be eligible to compete for Entrance Scholarships of the combined value of £410 in the following September, as well as for the numerous Medals, Scholarships, and Prizes awarded during the period of Studentship. The Hospital contains accommodation for 644 beds, and arrangements are being made as rapidly as possible to place the entire number at the service of the sick poor, by reopening the Wards that have been closed for want of funds for the last fifteen years.

The Appointments tenable by Students have recently been increased by more than 150 a year, chiefly by the addition of Clerkships and Dresserships in the departments of Ophthalmology, Gynecology, and Otolaryngology.

To augment the teaching of special subjects, Registrars and Tutors have been appointed in the Ophthalmic and Obstetric Departments.

All Hospital Appointments are open to Students without charge, and the holders of Resident Appointments are provided with board and lodging.

The College accommodates 60 Students, under the supervision of a Resident Warden.

The Dental School provides the full Curriculum required for the L.D.S. England.

The Clubs' Union Athletic Ground is easily accessible.

A Handbook of Information for those about to enter the Medical Profession will be forwarded on application.

For the Prospectus of the School, containing full particulars as to Fees, Course of Study advised, Regulations for Residents in the College, &c., apply personally, or by letter to the DEAN, Guy's Hospital, London Bridge, S.E.

GLASGOW ROYAL INFIRMARY.

The SUMMER SESSION opens on APRIL 24, 1900. The number of beds, including the Ophthalmic Department, is 612.

Special Wards and Beds are set apart for the treatment of the Diseases of Women, of the Throat and Nose and of the Ear; and there is a specially well-equipped department for the treatment of Diseases and Injury of the Eye. Women Students are admitted to the Clinical Teaching and Practice of the Infirmary; Medical and Surgical Wards being set apart for their exclusive use.

HOUSE APPOINTMENTS.—Five House Physicians and Seven House Surgeons are elected every six months, and an Assistant to the Gynecologist, who boards but is non-resident, is elected at the same time. Women are eligible for this appointment.

Dressers, Clinical Clerks, and Assistants to the Pathologist are selected from the Students.

BURSARIES.—The David Foulis Scholarship and the John Reid Prize, value £25 each, are open to Students of the Royal Infirmary.

Fees, which include Hospital Practice and the Clinical Lectures—for one year, £10 10s; six months, £6 6s; Three Months, £4 4s. The total fee is £21. Vaccination, £1 1s. Pathology, £4 4s. Bacteriology, £2 2s.

For further information apply to

M. THOMAS, M.D., Superintendent.

LIVERPOOL SCHOOL OF TROPICAL DISEASES.

IN CONNECTION WITH

UNIVERSITY COLLEGE AND ROYAL SOUTHERN HOSPITAL.

CLINICAL PRACTICE.—At the Royal Southern Hospital daily, in the Tropical Wards and Clinical Laboratories.

LABORATORY WORK.—Daily in the Thompson Yates Laboratories.

LECTURES.—Tropical Medicine thrice weekly.

COURSES.—Summer, Lent and Autumn Terms.

FEE.—Ten Guineas. Special arrangements for Board, and Special Terms for Private work.

RESEARCH.—Special facilities for research, and opportunities afforded of participating in expeditions.

The Course is open to fully qualified *Women Doctors*.

Next Term begins April 17th.

For prospectus and other particulars apply

A. H. MILNE, M.A., Hon. Sec.,
Chamber of Commerce, Liverpool.

THE LONDON SCHOOL OF TROPICAL MEDICINE

(UNDER THE AUSPICES OF HER MAJESTY'S GOVERNMENT),

CONNAUGHT ROAD, ALBERT DOCK, E.

IN CONNECTION WITH THE HOSPITALS OF THE SEAMEN'S HOSPITAL SOCIETY.

The next SESSION commences on TUESDAY, MAY 1, 1900.

For Prospectus, Syllabus, and other particulars, apply to the Secretary, P. MICHELL, Esq., Seamen's Hospital, Greenwich, S.E.; or to Dr. Rees, the Medical Tutor, at the School.

**BOTANICAL MATERIAL FOR CLASS WORK,
RESEARCH AND PRIVATE STUDENTS.**

J. BACKHOUSE & SON, LIMITED, YORK,

Having now established their new Scientific Department and Experimental Laboratory, are prepared to send Post free on application their new

50 PAGE CATALOGUE,

comprising Cryptogamic and Phanerogamic Material, fresh or preserved; Museum Specimens; Microscopical Preparations; &c., &c.

BIRKBECK INSTITUTION,

Breams Buildings, Chancery Lane, E.C.

Science Classes with Practical Work.

DAY AND EVENING CLASSES for University of London B.Sc.; Prelim. Scientific, Inter. M.B. Examinations and for Conjoint Board, Dental and Pharmaceutical Examinations.

EVENING CLASSES in all stages for Science and Art Department Examinations.

HIGHLY-EQUIPPED LABORATORIES.

Chemistry, Physics, Biology (Zoology and Botany), Metallurgy, Geology and Mineralogy, Microscopy.

Prospectus free. Calendar 6d. (Post 8d.) on application to Secretary.

ST. THOMAS'S HOSPITAL MEDICAL SCHOOL,

ALBERT EMBANKMENT, S.E.

The SUMMER SESSION will commence on TUESDAY, May 1. Students entering in the Summer are eligible to compete for the Science Scholarships of £150 and £60 awarded in October.

A Scholarship of £50, open to University Students, and other Prizes and Scholarships of the value of £500 are offered for annual competition. All Appointments are open to Students without extra payment.

Special Classes for the Examinations of the University of London are held throughout the year.

Tutorial Classes are held prior to the Second and Final Examinations of the Conjoint Board in January, April, and July.

A Register of approved lodgings and of private families receiving Boarders is kept in Secretary's Office.

Excellent Day Club accommodation is provided in the School Building, and an Athletic Ground at Chiswick.

Prospectuses and all particulars may be obtained from the Medical Secretary, Mr. G. RENDLE.

H. P. HAWKINS, M.A., M.D. Oxon., Dean.

UNIVERSITY COLLEGE, LONDON.

FACULTY OF MEDICINE.

The Summer Session begins on May 1st. The work is arranged so that a Student may advantageously begin his Medical Curriculum then.

Full information may be obtained from either of the undersigned.

H. R. SPENCER, M.D., F.R.C.P.,
Dean of the Faculty.

J. M. HORSEBURGH, M.A., Secretary.

**BEDFORD COLLEGE, LONDON
(FOR WOMEN),**

YORK PLACE, BAKER STREET, W.

The Easter Term begins on Thursday, April 26th.

Lectures are given in all branches of General and Higher Education.

Students are prepared for all the University of London Examinations in Arts and Science.

A Single Course of Lectures in any subject may be attended.

There is a Department for Professional Training in Teaching, and an Art School. Students can reside in the College.

Prospectus and all particulars on application to the PRINCIPAL.

**BEDFORD COLLEGE, LONDON
(FOR WOMEN),**

YORK PLACE, BAKER STREET, W.

ENTRANCE SCHOLARSHIPS.

The "Henry Tate Scholarship" in Science, annual value £50.

A Pfeiffer Scholarship in Science, annual value £48.

A Reid Scholarship in Arts, annual value £31 10s.

All tenable for three years.

Will be awarded on the results of the Examination to be held at the College on June 26th and 27th. Candidates must be under 19 years of age on the first day of the examination.

For further information apply to the PRINCIPAL.

BARGAINS IN TRAVEL BOOKS.

ASBOTH.—AN OFFICIAL TOUR THRO' BOSNIA AND HERZEGOVINA, by JOHN DE ASBOTH, Member of the Hungarian Diet, translated under the Author's supervision, Imperial 8vo, Cloth, with numerous Illustrations (pub. 21s.). 2s.
 "A most valuable work. . . Profusely illustrated."—*Athenaeum*.
 "Rich with history, personal adventure, and archaeological lore—a mine of information."—*Pall Mall Gazette*.

BONVALOT (G.), THROUGH THE HEART OF ASIA, OVER THE PAMIR TO INDIA, by GABRIEL BONVALOT, translated by C. B. PITMAN, with 250 Illustrations by ALBERT PÉPIN, 2 Vols., Royal 8vo, Cloth Gilt (pub. 32s.). 8s.

"The writer is a practised traveller, and the various accidents, dangers, and hardships encountered, are faced by the party with all the old traditional French lightness of heart. . . A steady flow of graphic description, amusing incidents, and characteristic talk with people of all classes; vain, ignorant, tyrannical khans, fever-stricken, apathetic peasants, pious pilgrims, and rude fanatics. . . The numerous illustrations are for the most part clever and artistic, and the pictures of scenery of a region little known, and rarely traversed by an artist of any skill, have a special interest."—*Athenaeum*.

BATTYE (A. Trevor), ICEBOUND ON KOLGUEV, a Chapter in the Exploration of Arctic Europe, with Illustrations by J. T. NETTLESHIP and CHARLES WHYMPER, Large Demy 8vo, Cloth (pub. 4s. 12. net). 5s. 6d.

"His book will take and keep an authoritative position. . . A modest and ungarbled picture of pluck and endurance that do honour to the English name. Ought to be secure of a welcome from a very large number of readers. . . The story is told in a delightfully simple and spontaneous manner. . . Mr. Trevor-Battye's simple and unaffected narrative enables us to learn a good deal."—*Times*.

Postage 6d. extra on one, or 8d. on two.

H. J. GLAISHER, New and Remainder Bookseller,
 57 WIGMORE STREET, LONDON, W.
Catalogues Post Free on application.

THE SCIENTIFIC ROLL AND MAGAZINE OF SYSTEMATIZED NOTES.

THIS WORK IS A VALUABLE
GUIDE, BIBLIOGRAPHY, AND INDEX TO SCIENCE.

In preparation.

BACTERIA (Botanical Section).

Although these are the simplest of plants, there is probably no group of organisms which exceeds them in interest or importance. Their operations affect the *welfare of every member of the community*, as also of the whole organic world. A full knowledge of them is essential in all questions bearing upon public and private health, agriculture, the microbial diseases of animals and of plants; and it is important in many industries, such as those dealing with milk, butter, hay, flax, tobacco, and others.

The group will be dealt with in three octavo volumes of about 500 pp. each. The subscription price will be 10s. for each volume, payable on delivery of the first number of the volume; or arrangements may be made to supply only the portions relating to a particular species, genus, or topic, at a proportionately reduced rate. The first volume will be commenced next summer, and if sufficient subscribers support the work, the three volumes will be completed in three years. As all the matter will be systematized, the series will be equivalent to a good bacteriological library, with the advantage that the information on any particular point will be comprised within a comparatively few pages, and not scattered over thousands of pages in a host of journals and books.

The names and addresses of subscribers, and applications for prospectus may be sent to the undersigned.

Bacteriologists are asked to communicate with the conductor at the address given below.

A. RAMSAY,
 4 Cowper Road, Acton, London, W.

ALBERT EDWARD JAMRACH
 (Late CHARLES JAMRACH),
 NATURALIST,
 180 ST. GEORGE STREET EAST.

Implements of Savage Warfare, Idols, Sacred Masks, Peruvian Pottery, Netsuke China, Lacquers, Gongs, Shells, and other Curios.

A. AND C. BLACK'S LIST.

A TREATISE ON ZOOLOGY.

By E. RAY LANKESTER, M.A., LL.D., F.R.S., Hon. Fellow of Exeter College, Oxford; Director of the Natural History Departments of the British Museum; Fullerian Professor of Physiology and Comparative Anatomy in the Royal Institution of London. Profusely Illustrated. To be completed in Ten Parts. NOW READY. Part III. THE ECHINODERMA. By F. A. BATHER, M.A., assisted by J. W. GREGORY, D.Sc., and E. S. GOODRICH, M.A. Demy 8vo, in paper covers, price 12s. 6d. net; or, in cloth, price 15s. net.

"It is marked by three characteristics, which indeed may be regarded as now indispensable to any scientific work of value—perfect lucidity in the illustrations, which are numerous, and, of course, specially drawn by, or under the direction of, the author; a careful exposition of the historical development of life-forms; and complete biographies on each branch of the subject."—*Literature*.

NOW READY. Demy 8vo, cloth, price 12s. 6d. net.

SEXUAL DIMORPHISM IN THE ANIMAL KINGDOM. A Theory of the Evolution of Secondary Sexual Characters. By J. T. CUNNINGHAM, M.A. Containing 32 Illustrations.

"Mr. Cunningham has elaborated a theory of evolution in answer to the problem: What are the causes which have produced the three kinds of structural difference in animals? He supports his theory by facts and illustrations drawn mainly from the works of others. A book of distinct scientific importance. The present volume is well printed and profusely illustrated with carefully executed figures."—*The Outlook*.

NOW READY. Crown 8vo, cloth, price 3s. 6d.

INTRODUCTION TO STRUCTURAL BOTANY. Part II. Flowerless Plants. Third Edition. By D. H. SCOTT, M.A., Ph.D., F.R.S., Honorary Keeper of the Jodrell Laboratory, Royal Gardens, Kew.

"It stands out from the ever-increasing crowd of guides, text-books, and manuals, in virtue not only of originality of design, but also of the fact that the subjects treated have been specially investigated for the purpose of the book, so that we have not the mere compilation of a book-man, but an account based on the results of the author's own observation."—*Natural Science*.

NOW READY. Post 8vo, cloth, price 12s. 6d.

ALGEBRA. An Elementary Text-book for the Higher Classes of Secondary Schools and Colleges. Part II. Second Edition. By Prof. GEORGE CHRYSAL, M.A., LL.D.

"It is the completest work on algebra that has yet come before us, and in lucidity of exposition it is second to none. The author views his subject from the high ground of the educationist, without reference to the exigencies of established examinations; yet neither the candidates who are training for such nor the teachers who prepare them will act wisely if they neglect his lessons."—*Athenaeum*.

NOW READY. Demy 8vo, cloth, price 7s. 6d. net.

THE GRAMMAR OF SCIENCE.

By KARL PEARSON, M.A., F.R.S., Professor of Applied Mathematics and Mechanics in University College, London. Second Edition, thoroughly Revised and much Enlarged. Contains Two entirely New Chapters on Natural Selection and Heredity, embracing a Popular Account of Prof. Pearson's own more recent work in this direction. Containing 33 Illustrations in the Text.

"There is a peculiar opportuneness about the appearance of a new edition of this clear exposition of the scientific method and the claims of science to be regarded as the educational instrument, par excellence, for a training in citizenship. . . We have been again and again impressed in examining 'The Grammar' with the remarkable lucidity of Prof. Pearson's explanations."—*The Grammar of Science*.

A. AND C. BLACK, SOHO SQUARE, LONDON.

The Agent-General for the Cape of Good

Hope has been instructed by the Colonial Government to publish the following notice:—

Applications are invited for the post of Dairy Instructor in the Government School at Elsberg (near Mulder's Vie), in the Cape Colony.

DUTIES.—To give instruction in all branches of Dairy-work and Poultry Farming, to take charge of the Dairy, Cattle and Pigs and Poultry, and to show a general interest in the conduct of Students.

A knowledge of Bacon-curing is desirable.

Salary, £250 per annum, with Quarters and Rations.

Travelling expenses from present domicile to Elsberg, up to £50, will be allowed.

The applicant should be unmarried.

Applications, with testimonials, to be addressed to Professor R. WALLACE, The University, Edinburgh, not later than the 20th April next.

112 Victoria Street, Westminster,

27th March, 1900.

HEATHCOTE SCIENCE LABORATORIES.

These Laboratories are open for RESEARCH work, at any hours or times most convenient for worker, in **CHEMISTRY, PHYSICS and BACTERIOLOGY**. Facilities for Commercial investigations are supplied. Furnaces and powerful Electrical Currents can be used.

The Fees are at rate of £3 3s. for one month (five days a week, six hours a day). Apparatus supplied free.

Private Laboratory, £4 14s. 6d. a month, or by arrangement.

The above Fees include use of all ordinary Glass and other Apparatus, and use of Accurate Balances and Standard General Instruments, also Furnaces, &c.

9 Heathcote Street, Mecklenburgh Square, | R. C. T. EVANS,
Gray's Inn Road, W.C. | Director.

B.A. AND B.Sc. EXAMINATIONS.

MATRICULATION, INTERMEDIATE, FINAL.

PREPARATION BY CORRESPONDENCE AND ORAL TUITION on a THOROUGHLY INDIVIDUAL SYSTEM. Fees based on success.

The STAFF includes Graduates of Oxford, Cambridge, London, and Royal Universities, Science Medalists, Priests, Scholars, &c.

SINGLE SUBJECTS TAKEN: Latin, Greek, French, German, Mathematics, Science, Logic, Psychology, Political Economy, &c.

For terms, &c., address Mr. J. CHARLESTON, B.A. (London and Oxon.), The Burlington Classes, 27 Chancery Lane, London, W.C.

INSTRUCTION IN PURE CULTIVATION OF YEAST,

According to **HANSEN'S Methods**.

Courses for Beginners, as well as for Advanced Students, in Physiology and Technology of Fermentations—Biological Analysis of Yeast.

Manuals:—E. Chr. Hansen: "Practical Studies in Fermentation." London (Spon), 1895. Alfred Jørgensen: "Micro-organisms and Fermentation." London (F. W. Lyon), 1893.

Further Particulars on Application to the Director, ALFRED JØRGENSEN, The Laboratory, Copenhagen, V.

Partner Wanted in a Scientific Manu-

facturing Business, with £1000 or upwards. Would suit Scientific Man or Son; exceptional opening; Capital wanted to carry out the Orders open, and—by enlarging Business—to avail of greatly increased trade waiting. Profits very large.—Address, "Scientific," care of NATURE Office.

SCIENCE MASTER WANTED, May 3.

for an Endowed School. University man looked for. Must be able to help with Lower Mathematics. Resident. Salary, £130 to £150 per Annum.—Apply P. T. O. GABBITAS, Thring & Co., 36 Sackville Street, London, W.

CHEMICAL LABORATORY STEWARD

REQUIRED for the Municipal Technical Institute, West Ham, E. Previous experience essential. Age not below 19. Wages, 27s. 6d. per Week, rising to 35s.—Apply by letter to the PRINCIPAL before April 18, giving particulars of previous experience.

W. G. PYE & CO.,

"GRANTA" WORKS, MILL LANE, CAMBRIDGE.

MAKERS OF PHYSICAL, PHYSIOLOGICAL, AND OTHER SCIENTIFIC INSTRUMENTS.

Sole Makers of Leake's Patent

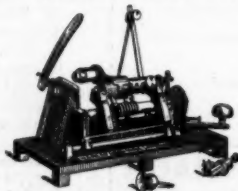
Flat-cutting Rocking Microtome.

Unsurpassed for ordinary work,

unequalled for Botanical work.

Price, as illustrated, in Case,

£26 6 0



LEAKE'S PATENT MICROTOME.

CAMBRIDGE PATTERN Rocking

Microtome, in Case, £23 5s.

Resistance Boxes from £3.

Improved Reflecting Galvanometers, £3.

School Galvanometers from 10s. 6d.

PYE'S Improved Pattern Boyle's Law Apparatus ... £1 5 0 As shown at the recent Educational Exhibition at South
" " Constant Volume Air Thermometer 0 15 0 Kensington with the Cambridge University Exhibits.
" " PRICE LISTS AND PAMPHLETS ON APPLICATION. (ILLUSTRATED CATALOGUE IN PREPARATION)

Apparatus for estimation of sulphur in spent oxide.

**FREDK. JACKSON & CO.**

(Late MOTTERSHED & CO.)

14 CROSS STREET, MANCHESTER.

Goods Entrance: 10 Half-Moon Street,

LABORATORY FURNISHERS,
Importers, Manufacturers, and Dealers in
**CHEMICAL AND PHYSICAL
APPARATUS**

Of every Description.

Fine Chemicals, Volumetric Solutions,
Plain and Stopped Bottles,

AND EVERY LABORATORY REQUIREMENT.

Illustrated Catalogue of Apparatus, with Price List
of Chemicals, free on application.

Telegraphic Address—"APPARATUS, MANCHESTER."

Telephone Number—2038.

LETCHER & SONS (formerly Letcher Bros.),

SCIENTIFIC INSTRUMENT MAKERS,

25 TURNPIKE LANE, HORNSEY, N.

BLOWPIPE CABINETS. SPECIALITY: SOCIETY OF ARTS SETS.

PRICE LIST, POST FREE, ON APPLICATION.

**T. TAMBLYN-WATTS,
SCIENTIFIC APPARATUS MAKER.**

Catalogue of Electrical Apparatus and Materials, 6d. Post free.
Catalogue of Balances and Weights, Apparatus for the Study
of Mechanics, &c., 6d. Post free.

GOLDIELANDS, SETTLE, YORKS.

Now Ready. 8vo. Price 4s. net.

INORGANIC EVOLUTION

AS STUDIED BY

SPECTRUM ANALYSIS.

BY

SIR NORMAN LOCKYER, K.C.B., F.R.S.

MACMILLAN AND CO., LTD., LONDON.

FLAT SKELETONS OF SMALL ANI-

MALS AND BIRDS, made end mounted in Glass-topped Boxes, by
Miss T. SMITH, Sladen Mount, Arnside, Westmoreland. Prices on
application.

CO-OPERATIVE WORLD TRAVEL

Organised by HENRY S. LUNN, M.D., F.R.G.S.,
W. HOLDSWORTH LUNN & CONNOP F.S. PEROWNE.

A Cruise to the CENTRAL MEDITERRANEAN.

(MARSEILLES, PALMA, ALGIERS, MALTA, SICILY, CAPRI,
NAPLES, MARSEILLES)

(Return Ticket to MARSEILLES included.)

AN EIGHTEEN DAYS' CRUISE FOR £21 OS. AND UPWARDS.

s.v. ARGONAUT. Tonnage, 3254; h.-p., 4000.

£10 10s. and £13 13s. TOURS TO ROME.

Extensions to NAPLES, FLORENCE, VENICE,
and the ITALIAN LAKES.

Full particulars from the Secretary, 5 Endsleigh Gardens,
Euston, London, N.W.

PHŒNIX FIRE OFFICE,

9 LOMBARD ST., E.C., and 57 CHARING CROSS, S.W.

ESTABLISHED 1782.

MODERATE RATES. ABSOLUTE SECURITY.

ELECTRIC LIGHTING RULES SUPPLIED.

LIBERAL LOSS SETTLEMENTS.

PROMPT PAYMENT OF CLAIMS.

FRANCIS B. MACDONALD, SECRETARY.

LOSSES PAID OVER £22,000,000.

SECOND-HAND MICROSCOPES

By SWIFT, WATSON, CROUCH, BECK, ZEISS, LEITZ, &c.
Prices from £2 10s. to £45.

A Large Selection of Second-hand Powers and Fittings for all kinds of
Microscopes.

Send for New List.

CLARKSON & CO., 28 Bartlett's Buildings, Holborn Circus, E.C.

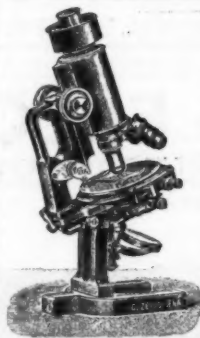
GLASS BLOWING.

All kinds of Experimental Glass
Blowing carried out for Scien-
tific Men, Laboratories, &c.

INVENTORS' IDEAS WORKED OUT AS PER
INSTRUCTIONS.

COSSOR,

67 Farringdon Road, E.C.



CARL ZEISS,

OPTICAL WORKS, JENA.

LONDON BRANCH:

29 MARGARET ST., REGENT ST., W.

NEW

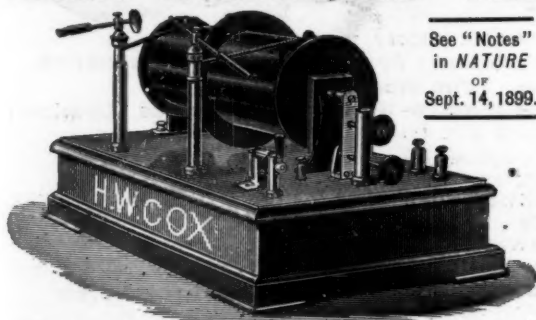
PHOTO-MICROGRAPHIC STAND

With very wide body-tube specially
designed for working with our MICRO-
PLANARS. It is also fitted with a new
Fine-Adjustment of great accuracy and
possessing a very slow movement.

These features render this Microscope
pre-eminently suitable for Photo-micro-
graphy with the highest and lowest powers,
as well as for ordinary visual observations.

DESCRIPTIVE PAMPHLET FREE ON APPLICATION.

X-RAY & ÆTHERIC TELEGRAPHY APPARATUS



See "Notes"
in NATURE
OF
Sept. 14, 1899.

OF THE HIGHEST QUALITY AND FINISH ONLY,
As supplied by us to H.M. Government and the leading
Hospitals and X-Ray Workers throughout the World.

We are the actual Manufacturers, and Guarantee
every Coil against breaking down.

CALL OR WRITE FOR OUR NEW ILLUSTRATED LIST, WITH
TESTIMONIALS AND ILLUSTRATED INSTRUCTIONS UPON HOW
TO WORK. POST FREE TO READERS OF "NATURE."

HARRY W. COX, Ltd.,

10, 11, 28 CURSITOR STREET,

CHANCERY LANE, LONDON.

Radiographs taken for Scientific and Medical Men, and
Demonstrations given.

MOORE'S HYDROSTATIC BALANCE



FOR ILLUSTRATING THE "PRINCIPLE OF ARCHIMEDES" AND SPECIFIC GRAVITY.

A is a delicate spring balance accurately graduated to read Grams, and is capable of being lowered or raised by the string shown.

B is one of the set of cubes of various metals supplied with the apparatus.

C is a glass vessel with fixed mark etched in glass, up to which water, or other liquid, is placed. The vessel is provided with draw-off cock.

Sole Makers of this Apparatus—

BREWSTER, SMITH, & CO.,

6 CROSS STREET, FINSBURY, E.C.

Manufacturers and Importers of Chemical and Scientific Apparatus and Pure Chemicals.

WEIGHTS a Speciality, 500 Milligrams to 1 Milligram, 12. 6d. per doz.

SEND FOR COMPLETE ILLUSTRATED CATALOGUE.

SPECTROPHOTOGRAPHY.

All requirements for Spectrophotography; Cameras of wood or metal adapted to any Spectroscope, and fitted with all necessary adjustments; Spectroscopes specially designed for photographic work.

Prisms and Lenses of Quartz, and Prisms of Iceland Spar for Photography of the Ultra-Violet Spectrum. Rowland's Diffraction Gratings always in stock.

ABSORPTION SPECTRA.

Bottle Prisms, with Quartz or Glass Plates; Schulze Cells; Double Slits, &c., for the study of Absorption Spectra.

THE ZEEMAN EFFECT.

Mr. HILGER is now making Michelson's "Echelon" Diffraction Gratings. The "Echelon" is the most powerful instrument yet devised for the minute analysis of fine spectral lines, and in particular for the observation of the Zeeman Effect.

A. HILGER, 204 Stanhope St., Hampstead Rd., London, N.W.

L. CASELLA,

Scientific Instrument Maker,
Engineer, &c.



THEODOLITES.

LEVELS.

SEXTANTS.

HORIZONS.

COMPASSES.

TELEMETERS.

TIDE GAUGES.

STEAM AND PRESSURE GAUGES.

ANEROIDS.

&c., &c.

PARTICULARS AND PRICES MAY BE
HAD ON APPLICATION.

WRITE FOR DESCRIPTIVE PAMPHLETS AND CATALOGUES
OF SURVEYING INSTRUMENTS, &c.

147 Holborn Bars,
LONDON, E.C.

Telegraphic Address:—"ESCUTCHEON, LONDON."
Telephone:—No. 1054, HOLBORN.

A REALLY SCIENTIFIC AND PRACTICAL NOVELTY.

THE "EVER READY" ELECTRIC TORCH

Shoots an **EXTREMELY POWERFUL** Light
into Dark Places.

SIMPLICITY
ITSELF.

No Wires.

No Chemicals.

No Danger.



THE MOST SERVICEABLE ELECTRIC LIGHT YET INVENTED.

MATCHES, TAPERS, CANDLES, HAND-LAMPS (Always a Danger) **ENTIRELY SUPERSEDED.**
No Leak—No Liquid. Wind Proof—No Flame. Fire Proof—No Heat.

Non-Explosive—No Gas or Dangerous Chemicals.

A CHILD CAN USE IT.

Ready to pour a Flood of Light about your bedroom, along dark halls, stairways, and cellars, at any instant.

A SEARCH-LIGHT into Dark Corners unequalled for HOUSEHOLD PURPOSES.

PENETRATES all RECESSES, CUPBOARDS, and LOCKERS for HOUSEWIVES.

CHEAP. CLEAN. EFFECTIVE.

IT'S A USEFUL, HARMLESS BUSYBODY.

Size No. 1. Price (with Battery complete) 18s. Size No. 1. Extra Battery, 1s. 6d. Larger sizes, 25s. and 30s. each.
After 6000 to 8000 flashes then "refill" batteries can be slipped in at a moment's notice, and torch is as good as new.

W. & J. GEORGE, LTD., 33-37 HATTON WALL, LONDON.
(Late F. E. BECKER & CO.)

ISENTHAL, POTZLER & CO.,

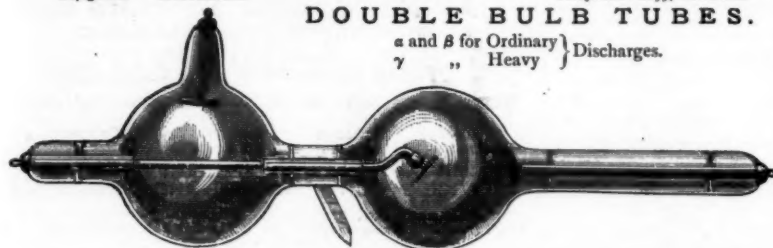
85 MORTIMER STREET, LONDON, W.

Telegrams "HYSTERESIS."

Telephone: 3099, GERRARD.

DOUBLE BULB TUBES.

α and β for Ordinary } Discharges.
 γ " Heavy }



CENTRAL DEPÔT FOR RADIOGRAPHERS.

Write for Lists, or better inspect our Installations.

HIGHEST REFERENCES.
EVERYTHING NOVEL AND ORIGINAL.

SOLE AGENTS FOR SCOTLAND:
Messrs. JAMES WHITE,
Cambridge St., Glasgow.

DUDELL OSCILLOGRAPH

An Invaluable Instrument for Alternating Current Work.

This Galvanometer has the shortest periodic time of any Instrument yet constructed, viz. 0.0001 Second, is perfectly dead-beat and the self-induction is practically nil.

Write for Descriptive Pamphlet.

SOLE MAKERS—

SCIENTIFIC INSTRUMENT CO.
LIMITED,
CAMBRIDGE.

NEW SCIENCE LANTERN.

SOLE MAKERS:
REYNOLDS & BRANSON,
Ltd.

IMPROVED
PORTABLE
DESIGN.



The Universal Science Lantern has been devised for the projection of experiments. In the short box in front of the lantern is a hinged mirror, so placed that by the movement of a stud it may be introduced and placed at an angle of 45 degrees with the parallel beam. The beam is thus sent upwards through a horizontal convergent lens, on which a slide or horizontal piece of apparatus can be placed. Above this is the objective mounted on a brass pillar, and above the objective a prism or mirror (if the screen is elevated above the lantern plain prisms are required for each beam), silvered on the outside so that there is no double reflection. The mirror can be adjusted to any angle, and is intended to send the image in an approximately horizontal direction to the screen. Slides can also be directly projected in the usual way.

The base-board is made to fold so that the lantern can be packed into a box 18 $\frac{1}{2}$ x 8 $\frac{1}{2}$ x 20 $\frac{1}{2}$ with all its accessories *in situ*.

Price Complete, in Travelling Box, £9 0 0

REYNOLDS & BRANSON, LTD.
14 COMMERCIAL STREET, LEEDS.

A USEFUL COMPANION FOR THE SCIENTIFIC MAN.

Can be conveniently carried in the pocket, and, therefore, always handy for making notes.

Writes the moment it touches the paper.

Can be used in any position.

Has:—
A Nib of
14-carat Gold.

A Holder of the
Finest Vulcanised
Rubber.

A Perfect Feed, which
ensures absolute regularity of working.

Made in various styles, and with Nibs to suit all hands.

"E" PRICE LIST SENT POST FREE.

The YÖST TYPEWRITER Co., Ltd.,
50 HOLBORN VIADUCT, LONDON, E.C.

WEST END DEPÔT:—303 Oxford Street.



LIVING SPECIMENS FOR THE MICROSCOPE.

Volvox, Spirogyra, Desmids, Diatoms, Amoeba, Arcella, Actinosphaerium, Vorticella, Stentor, Hydra, Floscularia, Stephanoceros, Melicerta, and many other Specimens of Pond Life. Price 1s. per Tube, Post Free. Helix pomatia, Astacus, Amphioxus, Rana, Anodon, &c., for Dissection purposes.

THOMAS BOLTON,

25 BALSALL HEATH ROAD, BIRMINGHAM.

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM.

THE LABORATORY, PLYMOUTH.

The following animals can always be supplied, either living or preserved by the best methods:—

Sycon; Clava, Obelia, Sertularia; Actinia, Tealia, Caryophyllia, Alcyonium; Hormiphora (preserved); Leptopiana; Lineus, Amphiporus; Nereis, Aphrodite, Arenicola, Lanice, Terebella; Lepas, Balanus, Gammarus, Ligia, Mysid, Nebalia, Carcinus; Patella, Buccinum, Eledone, Pecten, Bugula, Crisia, Pedicellina, Holothuria, Asterias, Echinus; Ascidia, Salpa (preserved), Scyllium, Raja, &c., &c.

For prices and more detailed lists apply to Biological Laboratory, Plymouth.

THE DIRECTOR.

THE MOST NUTRITIOUS.

E P P S'S

GRATEFUL—COMFORTING.

C O C O A

BREAKFAST—SUPPER.

HOLLOWAY'S OINTMENT

CURES

Gout, Rheumatism, Lumbago, Sciatica, Cuts, Bruises, Sprains, &c.

INVALUABLE FOR ALL SKIN DISEASES.

Holloway's Ointment and Pills may be obtained of all Medicine Vendors.

THE IRISH NATURALIST.

A Monthly Magazine of Irish Zoology, Botany, and Geology. Price 6d.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD PRAEGER, B.A.

Annual Subscription, 5s. Post Free to any Address.

Dublin: EASON & SON, LTD., 40 Lower Sackville Street (to which Address Subscriptions should be sent).

London: SIMPKIN, MARSHALL, HAMILTON, KENT, & CO., Ltd

WATKINS & DONCASTER,

NATURALISTS,
AND MANUFACTURERS OF

CABINETS AND APPARATUS

FOR ENTOMOLOGY, BIRDS' EGGS, AND ALL BRANCHES OF NATURAL HISTORY.

SPECIAL SHOW-ROOM FOR CABINETS.

Call or send for detailed Catalogue (88 pp.), Post free on application.

N.B.—For Excellence and Superiority of Cabinets and Apparatus, references are permitted to distinguished patrons, Museums, Colleges, &c.

A LARGE STOCK OF INSECTS AND BIRDS' EGGS.

Birds, Mammals, &c., Preserved and Mounted by First-class Workmen with true natural surroundings. All Books and Publications on Natural History supplied.

36 STRAND, LONDON, W.C.

(Five Doors from Charing Cross.)

MINERALS, ROCKS & FOSSILS.

COLLECTIONS FOR STUDENTS.

Carefully labelled and arranged in Boxes with Card Trays.

50 Minerals, 12/6; 100 do., 21/-; 200 do., 42/-.

Rocks and Fossils at similar prices.

300 Minerals in Cabinet, £4 4s.; 400 do., £5 12s. 6d.

Catalogues Post Free.

THOMAS D. RUSSELL,

78 NEWGATE STREET, LONDON, E.C.

THE SCIENTIFIC ROLL

AND MAGAZINE OF SYSTEMATIZED NOTES
METEOROLOGICAL SECTION.

CLIMATE: GENERAL. 4s.
CLIMATE: AQUEOUS VAPOUR. 6s.
CLIMATE: BARIC CONDITION. 6s. [Reprinting.

The last No. is in Press. Present Subscription Price, 10s.

To be followed by
CARBONIC ACID, CHEMICAL RAYS, &c., to WIND.

O DRISCOLL, LENNOX & CO., 10 and 12 Elephant Road, Elephant and Castle, London, S.E.

THE ENTOMOLOGISTS' MONTHLY MAGAZINE.

Price Sixpence, Monthly

Edited by C. G. BARRETT, G. C. CHAMPION, F.Z.S., J. W. DOUGLAS, W. W. FOWLER, M.A., F.L.S., R. McLACHLAN, F.R.S., E. SAUNDERS, F.L.S., and

LORD WALSHINGHAM, M.A., LL.D., F.R.S.

This Magazine, commenced in 1854, contains standard articles and notes on all subjects connected with Entomology, and especially on the Insects of the British Isles.

Subscription—Six Shillings per Annum, post free.

London: GURNEY & JACKSON (Mr. Van Voorst's Successors), 1 Paternoster Row.

SCIENTIFIC WORTHIES.

The following is a list of the Steel Portraits that have appeared in the above Series:—

MICHAEL FARADAY.
THOMAS HENRY HUXLEY.
CHARLES DARWIN.
JOHN TYNDALL.
SIR GEORGE GABRIEL STOKES.
SIR CHARLES LYELL.
SIR CHARLES WHEATSTONE.
SIR WYVILLE THOMSON.
ROBERT WILHELM BUNSEN.
LORD KELVIN.
BARON ADOLF ERIK NOR-
DENSKJÖLD.

HERMANN L. F. HELMHOLTZ.
SIR JOSEPH DALTON HOOKER.
WILLIAM HARVEY.
SIR GEORGE B. AIRY.
J. LOUIS R. AGASSIZ.
JEAN BAPTISTE ANDRÉ DUMAS.
SIR RICHARD OWEN.
JAMES CLERK MAXWELL.
JAMES PRESCOTT JOULE.
WILLIAM SPOTTISWOODE.
ARTHUR CAYLEY.
SIR C. W. SIEMENS.

JOHN COUCH ADAMS.
JAMES JOSEPH SYLVESTER.
DMITRI IVANOWITSH MEN-
DELEEF.
LOUIS PASTEUR.

SIR ARCHIBALD GEIKIE.
LORD LISTER.
STANISLAO CANNIZZARO.
PROF. VON KÖLLIKER.
PROF. SIMON NEWCOMB.

N.B.—The Portraits of Sir A. Geikie, Lord Lister, Prof. Cannizzaro, Prof. von Kölliker, and Prof. S. Newcomb belong to a New Series and are Photogravures.

Proof impressions of these, printed on India paper, may be had from the Publishers, price 5s. each; or the Series of 32 Portraits in a Handsome Portfolio for £8 5s., carriage paid. The Portfolio may be had separately, price 6s.

Cheques and Money Orders payable to MACMILLAN & CO., Limited.

OFFICE OF "NATURE," ST. MARTIN'S STREET, LONDON, W.C.

MACMILLAN & CO.'S NEW AND RECENT BOOKS FOR STUDENTS OF ZOOLOGY. AN ELEMENTARY COURSE OF PRACTICAL ZOOLOGY.

By the late **T. JEFFERY PARKER**, D.Sc., F.R.S., Professor of Biology in the University of Otago, Dunedin, New Zealand, and **W. NEWTON PARKER**, Ph.D., Professor of Zoology at the University College of South Wales and Monmouthshire, in the University of Wales. With 156 Illustrations. Crown 8vo. 10s. 6d.

LANCET.—"Will be found serviceable to the upper classes of schools where natural history is taught, and to classes for elementary biology in medical schools."

A MANUAL OF ZOOLOGY.

By the late Prof. **T. J. PARKER**, D.Sc., F.R.S., and Prof. **W. A. HASWELL**, M.A., D.Sc., F.R.S.
With Three Hundred Illustrations. Crown 8vo, 10s. 6d.

ZOOLOGIST.—"The present publication may be considered a condensation of the previous work ('A Text-Book of Zoology'). . . . Thus we have the essence of a really good book in a convenient form for teachers and students."

FIELD.—"For those who require a manual to assist them in acquiring an accurate knowledge of zoology we know of no book superior to that under notice. . . . The illustrations are admirable. We know of no work better fitted to fulfil the purpose for which it was designed than the one under notice. It is an admirable introductory text-book to scientific zoology."

A TEXT-BOOK OF ZOOLOGY.

By **T. JEFFERY PARKER**, D.Sc., F.R.S.,

Professor of Biology in the University of Otago, Dunedin, N.Z., and **WILLIAM A. HASWELL**, M.A., D.Sc., F.R.S., Professor of Biology in the University of Sydney, N.S.W. In Two Vols. With Illustrations. Medium 8vo, 36s. net.

SCIENCE PROGRESS.—"The appearance of this important work, for which many of us have been eagerly waiting, will be hailed with pleasure. . . . When we consider the difficulties under which these authors laboured, one in New Zealand the other in Sydney, the printers, publishers and artists in England, one can only marvel at the splendid work they have produced, one that will be useful both to the elementary and advanced student alike, as well as to the teacher."

THE CAMBRIDGE NATURAL HISTORY.

EDITED BY **S. F. HARMER**, M.A., AND **A. E. SHIPLEY**, M.A.

TO BE COMPLETED IN TEN VOLUMES. 8vo. PRICE 17s. NET EACH.

WORMS, LEECHES, &c.

VOLUME II.

Flatworms. By **F. W. GAMBLE**, M.Sc. Vict., Owens College. **Nemertines.** By **Miss L. SHEDDEN**. **Threadworms, &c.** By **A. E. SHIPLEY**, M.A. **Rotifers.** By **Professor MARCUS HARTOG**, M.A., D.Sc. Lond. **Polychaet Worms.** By **W. BLAXLAND BENHAM**, D.Sc. Lond., Hon. M.A. Oxon. **Earthworms and Leeches.** By **F. E. BEDDARD**, M.A. Oxon., F.R.S. **Gephyrea, &c.** By **A. E. SHIPLEY**, M.A. **Polyzoa.** By **S. F. HARMER**, M.A.
NATURE.—"Taken as a whole the book is fully worthy of its place in this attractive series."

SHELLS.

VOLUME III.

Molluscs and Brachiopods. By the **Rev. A. H. COOKE**, M.A., **A. E. SHIPLEY**, M.A., and **F. R. C. REED**, M.A.

FIELD.—"We know of no book available to the general reader which affords such a vast fund of information on the structure and habits of molluscs."

INSECTS & CENTIPEDES.

VOLUME V.

Peripatus. By **ADAM SEDGWICK**, M.A., F.R.S. **Myriapods.** By **F. G. SINCLAIR**, M.A. **Insects. Part I.** By **DAVID SHARP**, M.A. Cantab., M.B. Edin., F.R.S.

ATHENÆUM.—"This book will find a place in the library of most entomologists, prove a welcome boon to weak brethren who are compelled to lecture—*docendo discimus*—and occupy by the side of Westwood's 'Modern Classification' and 'Burmester's Manual' a niche that has long been empty."

INSECTS.

VOLUME VI.

Part II. Hymenoptera continued (Tubulifera and Aculeata), Coleoptera, Strepsiptera, Lepidoptera, Diptera, Aphaniptera, Thysanoptera, Hemiptera, Anoplura. By **DAVID SHARP**, M.A. Cantab., M.B. Edin., F.R.S.

ENTOMOLOGIST'S RECORD.—"Too much cannot be said in praise of this work, which offers to the general naturalist, as well as to the specialist, a thoroughly reliable text-book that is distinctly in advance of any other work of a similar kind yet published in the English language."

BIRDS.

VOLUME IX.

By **A. H. EVANS**. With numerous Illustrations by **G. E. LODGE**.

NATURE NOTES.—"We venture to predict that, of the ten volumes of which this excellent series is planned to consist, none will secure a wider popularity than Mr. Evans' treatise on birds. Strange as it may appear, among the many books on birds that have appeared of late years, we do not recall any that covers the same ground. . . . We are grateful to the author for the mine of valuable information which he has crowded between his two covers."

* * The remaining five volumes, dealing with **PROTOZOA** (including Sea Anemones, Jelly Fish, Star Fish, &c.); **SPIDERS, SCORPIONS, and CRUSTACEA**; **FISHES and THEIR KINDRED**; **AMPHIBIA and REPTILES**; and **MAMMALS**, are all in active preparation.

MACMILLAN AND CO., LIMITED, LONDON.

MACMILLAN & CO.'S NEW SCIENTIFIC BOOKS.

MICRO-ORGANISMS AND FERMENTATION.

By ALFRED JÖRGENSEN,

Director of the Laboratory for the Physiology and Technology of Fermentation at Copenhagen. Translated by ALEX. K. MILLER, Ph.D., F.I.C., and A. E. LENNHOLM. Third Edition, completely Revised. With 83 Illustrations. 8vo. 10s. net. [Just ready.]

TEXT-BOOK OF PALÆONTOLOGY.

By KARL A. VON ZITTEL,

Professor of Geology and Palæontology in the University of Munich. Translated and Edited by CHAS. R. EASTMAN, Ph.D., Assistant in Palæontology in the Museum of Comparative Zoology at Harvard. With 1476 Woodcuts. Medium 8vo. 25s. net.

* * This English Edition is revised and enlarged by the Author and Editor in collaboration with numerous Specialists.

SPEAKER.—"In this sphere Prof. Zittel's books have long held the field as the standard works of their class, but to many they have been inaccessible on account of their being in a foreign tongue. . . . It has not merely been translated; it has been edited and brought up to date as well. . . . The author and editor have conferred a great boon upon their fellow-workers, whether English or foreign, by bringing out what is really a new edition of this work. . . . A most valuable addition to the scientific literature of the world, and the publication of the second volume, dealing with the Vertebrata, will be awaited with the keenest interest on all sides."

ENLARGED AND REVISED EDITION NOW READY.

LESSONS IN ELEMENTARY PHYSIOLOGY.

BY THOMAS H. HUXLEY, LL.D., F.R.S.

Enlarged and Revised Edition. Globe 8vo. 4s. 6d.

VOL. III. (COMPLETING THE WORK) NOW READY.

DICTIONARY OF POLITICAL ECONOMY. Edited by R. H. INGLIS PALGRAVE.

Vol. III. (completing the work). Medium 8vo, 21s. net. Also ready, Vols. I and II., 21s. net each.

ECONOMIC JOURNAL.—"The list of contributors is a brilliant one. They have played their parts well, and the editor has managed them with great ability. . . . If its success is at all commensurate with its deserts, the publishers may congratulate themselves upon a very valuable venture. No working economist can afford to be without this dictionary. Mr. Palgrave's dictionary emerges successfully from the severe test of comparison with its French and German predecessors."

DEMOCRACY AND EMPIRE, WITH STUDIES OF THEIR PSYCHOLOGICAL, ECONOMIC, AND MORAL FOUNDATIONS. By FRANKLIN HENRY GIDDINGS, M.A., Ph.D., Professor in Columbia University, New York. 8vo. 8s. 6d. net.

SPEAKER.—"The actuality in Professor Giddings' political philosophy, the vigour of his style, and the choice of his subjects, are likely to win him a large audience. And his point of view deserves careful study."

MONOPOLISTS AND TRUSTS. By RICHARD T. ELY, Ph.D., LL.D., Professor of Political Economy and Director of the School of Economics, Political Science, and History in the University of Wisconsin. Crown 8vo. 5s. net.

[The Citizen's Library.]

INTRODUCTION TO PHYSICAL CHEMISTRY. By JAMES WALKER, D.Sc., Ph.D., Professor of Chemistry in University College, Dundee. 8vo. 10s. net.

GUARDIAN.—"It is with great satisfaction that we welcome the appearance of this valuable text-book. . . . It is the most important purely English work of the kind that has yet appeared. . . . The best introduction to physical chemistry at present available."

THE THEORY OF ELECTROLYTIC DISSOCIATION AND SOME OF ITS APPLICATIONS. By HARRY C. JONES, Associate in Physical Chemistry in Johns Hopkins University. Extra crown 8vo. 7s. net.

SPECTATOR.—"An interesting study. . . . It is written easily, the historical sequence of the experiments is preserved, and, finally, it proves that a purely scientific subject can be treated with style and simplicity if the writer keeps in view his real aim, the instruction of others."

THE PHYSICAL REVIEW.

A JOURNAL OF EXPERIMENTAL AND THEORETICAL PHYSICS.

CONDUCTED BY EDWARD L. NICHOLS, ERNEST MERRITT, AND FREDERICK BEDELL

No. 2, VOL. X., FEBRUARY, 1900. PRICE 3s. NET.

CONTENTS.—The Influence of Electrification on the Surface Tension of Water and Mercury. By Ernest Merritt and Samuel J. Barnett.—An Objective Representation of the Hysteresis of Iron and Steel. By Knut Ångström.—A Determination of the Nature of the Electric and Magnetic Quantities, and of the Density and Elasticity of the Ether. II. By Reginald A. Fessenden.—Thermodynamic Notes (No. 10): Revision of some Thermal Data concerning Benzene. By K. Tsuruta.—An Efficient Boyle's Law Apparatus. By W. J. Humphreys.—New Books.

MACMILLAN AND CO., LIMITED, LONDON.

MINERALOGY.

Micro. Slides, Collections and Single Specimens of Minerals, Rocks and Precious Stones, for the Student, Teacher and Prospector.
Elementary Collections in Case, 40 Specimens in Case, 6s. Blowpipe Cases and all necessaries for Field or Class Work.

LESSONS GIVEN.

SAMUEL HENSON,
97 REGENT STREET, LONDON, W.
ESTABLISHED 1840.

PHYSIOGRAPHY and GEOLOGY. COLLECTIONS & MICROSCOPIC SLIDES,

As advised by Science and Art Directory, arranged by
JAMES R. GREGORY & CO.,
Mineralogists, &c.
To Science and Art Department, British, Indian and Colonial
Museums, &c.

NOVELTIES and RARE GEMS and PRECIOUS STONES.

*Mineral Specimens for Museums, and Collectors, and all purposes.
Rock Specimens and Microscopic Sections of Rocks and Minerals
cut to order.*

NEW AND VALUABLE MINERAL SPECIMENS CONSTANTLY
ARRIVING.

Stores & Offices: 1 Kelson Place, KENSINGTON, W.
NEW CATALOGUES AND LISTS FREE.

ESTABLISHED 1851.

BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

INVESTED FUNDS

£10,000,000.

The BIRKBECK ALMANACK, with full particulars, post free.

FRANCIS RAVENSCROFT, Manager.

TO SCIENCE LECTURERS. HUGHES' MOTO-PHOTOSCOPE FOR LIVING PICTURES.

THE MOST PERFECT.

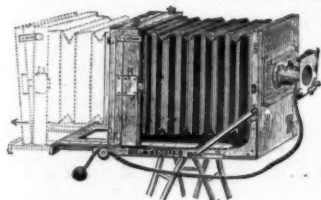
No SHUTTER, therefore no Flickering. Superb Mechanism.

*The Moto-Photo Camera for taking the Pictures. Illustrated Lists, ad-
See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN,
&c. Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great
success. New Oxyhydrogen Microscope. Science Lanterns for Clas-
Demonstration. Magnificent Results. Docwra Triple, Prize Medals
Highest Award. Supplied to the Royal Polytechnic Institution, Dr. H. GRAY-
TAN GUINNESS, Madame ADELINA PATTI, &c., &c. Patent Pamphengos,
Science Lanterns. The Universal Lantern 4-inch Condensers, 4-wick Lamp,
Portrait Combination front Lenses, 18s. 6d., Marvellous value. Science
Lecture Sets. Novelties. The Lantern Kaleidoscope. Cheapest Lantern
Outfits in the World. Grandly Illustrated Catalogue, over 150 choice En-
gravings, 6d.; Postage, 3d. List of 300 Lecture Sets, Science Subjects,
Views, &c., 6d.; Postage 3d. Pamphlets Free. W. C. HUGHES,
SPECIALIST, Brawster House, 83 Mortimer Road, Kingsland, N.*

TRADE
MARK

"OPTIMUS."

TELEGRAPHIC
ADDRESS.



**PHOTOGRAPHIC
APPARATUS**
OF BEST WORKMANSHIP
FOR ALL PURPOSES.



Catalogue POST FREE.

PERKEN, SON & CO., LTD., 99, HATTON GARDEN, LONDON.
HOLBORN CIRCUS, E.C.

HARVEY & PEAK

(BY APPOINTMENT TO THE ROYAL INSTITUTION OF GREAT BRITAIN)

HAVE FOR DISPOSAL A NUMBER OF

NICOL PRISMS AND TOURMALINES of various Sizes.

PROJECTION POLARISCOPES of various Sizes in Stock, with large Nicol Prisms:—
STUDENTS' SPECTROMETERS.—P. O. Bridge Sets, for Schools.—Induction Coils.—Wimshurst Machines.—
X-Ray Apparatus.—Optical Banks, &c., &c.

H. & P. are the actual Manufacturers of the above.

56 CHARING CROSS ROAD, LONDON, W.C.

NOTICE.—Advertisements and business letters for NATURE should be addressed to the Publishers; Editorial communications to the Editor. The telegraphic address of NATURE is "PHUSIS," LONDON.

SUBSCRIPTIONS TO "NATURE."

	£	s.	d.
Yearly	1	8	0
Half-yearly	0	14	6
Quarterly	0	7	6
TO ALL PLACES ABROAD:—			
Yearly	1	10	6
Half-yearly	0	15	5
Quarterly	0	8	0

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
*Three Lines in Column	0	2	6
Per Line after	0	0	9
One Eighth Page, or Quarter Column	0	18	6
Quarter Page, or Half a Column	1	15	0
Half a Page, or a Column	3	5	0
Whole Page	6	6	0

*The first line being in heavy type is charged for as Two Lines.

Cheques and Money Orders payable to **MACMILLAN & CO., Limited.**

OFFICE: ST MARTIN'S STREET, LONDON, W.C.



HARRIS'S ORIGINAL PATTERN ATWOOD MACHINE, 1892A, Accurate and Reliable, 8 to 9 feet high, Graduated, £3 15s.

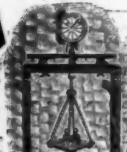
HARRIS'S SPECIALITIES.—CATALOGUES UPON APPLICATION.



Reliable Balances, 1899A. 100 grm. to 1 mgm. Agate Planes and Knife Edges, £1 9s. 6d.; Steel £1 4s.



Resistance Box, Post Office, £6 10s. 4775A.



New Mechanical Apparatus. See List.



Stroud and Rendell Lantern, £5. 6s. 9s. 6d.

PHILIP HARRIS & Co., LTD., COMPLETE LABORATORY FURNISHERS, BIRMINGHAM.

Tel-graphic Address :
"Science," Birmingham.
Telephone No. 10.

WATSON'S NEW MICROSCOPES AND APPARATUS.



WATSON'S HOLOSCOPIC EYEPIECES, for use with either APOCHROMATIC or ACHROMATIC OBJECTIVES, an adjustment being provided to the special lenses employed, for altering the correction. There is no sacrifice of efficiency, the performance being equal to the most expensive Compensating or Huyghenian Oculars.

Magnifying Powers—

6 in. tube length, 5, 7, 10, and 14 diameters.
10 in. " " 7, 10, 14, and 20 " "

PRICE, in Student's Size and Pattern, either power, 17/6 each.

For Full Particulars see Supplemental List, Post Free.

WATSON'S Parachromatic OIL IMMERSION CONDENSER.

Total aperture, 1.90; applanatic aperture exceeds 1.25. Undoubtedly the finest Condenser obtainable for high-power work. Optical part only ... £5 0 0

Completely mounted with Iris Diaphragm and Set of Stops ... £6 10 0

WATSON'S "SCHOOL" MICROSCOPE, New Model, complete with 1 in. Objective, in Case ... £3 3 0

WATSON'S "ROYAL" MICROSCOPE. A new model high-class instrument.

WATSON'S "FRAM" MICROSCOPE. A highest-class instrument at a very moderate cost.

BACTERIOLOGICAL APPARATUS. MICROTOMES. Apparatus for FIELD BOTANY and FIELD GEOLOGY. METAMORPHOSES and DISSECTED PREPARATIONS. BOTANICAL and PHYSIOLOGICAL MODELS.

For Particulars of all the above, see

Watson's New Supplemental List to Catalogue No. 2, Post Free on application.

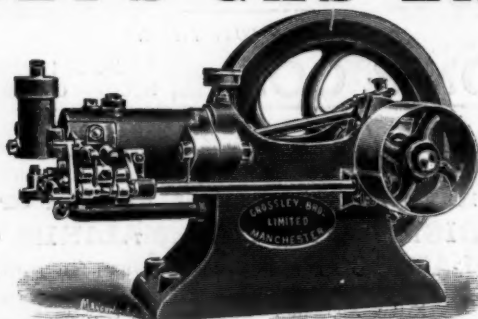
Watson's Catalogue (No. 3) is a Classified List representing a Stock of 40,000 first-class Micro-Slides, Post free on application.

W. WATSON & SONS (Established 1837), Opticians to H.M. Government.

313 HIGH HOLBORN, LONDON, W.C. New Branch Now Open: 16 FORREST ROAD, EDINBURGH. And at 78 Swanston Street, Melbourne, Australia. Awarded 39 Gold and other Medals at the principal International Exhibitions of the World.

CROSSLEY'S GAS ENGINES.

RECENTLY
REMODELLED.



GREAT
REDUCTION
IN
GAS
CONSUMED.

CROSSLEY BROS., LTD., OPENSHAW, MANCHESTER.

THE NEW STIGMATIC LENS.

SERIES II. F/6.

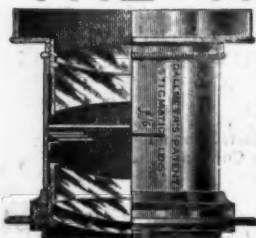
BRITISH DESIGN AND WORKMANSHIP.

Is the best All-round Lens for either Professional or Amateur use.

Each lens will give perfect definition with full aperture to the extreme corners of the plate it is sold to cover; with smaller stops it will cover at least two sizes larger, giving perfect sharpness all over the plate, and thus becoming a wide-angle lens of the highest excellence. Either combination may be used separately, giving foci of about $1\frac{1}{2}$ and 2 times the length of that of the lens when used intact. The advantage of thus being able to choose the best point of view, irrespective of distance, will be at once apparent to the artistic worker.

EQUIVALENT TO FOUR LENSES AT THE PRICE OF ONE.

Eleven Sizes are now ready from $\frac{3}{4}$ to 18 inches eq. focus.



CATALOGUE OF HIGH-CLASS CAMERAS AND LENSES, POST FREE.

J. H. DALLMEYER, Ltd., 25 NEWMAN STREET, OXFORD STREET, LONDON, W.

Printed by H. B. CLAY AND SONS, LIMITED, at 7 & 8 Broad Street Hill, Queen Victoria Street, in the City of London and published by MACMILLAN AND CO. LIMITED, at St. Martin's Street, London, W.C., and THE MACMILLAN COMPANY, 66 Fifth Avenue, New York.—THURSDAY, April 5, 1900.



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 1589, VOL. 61]

THURSDAY, APRIL 12, 1900.

[PRICE SIXPENCE.

Registered as a Newspaper at the General Post Office.]

[All Rights are Reserved.

WIRELESS TELEGRAPHY.

The "APPS-NEWTON" INDUCTION COILS have proved far superior to all others in telegraphing long distances without wires.

They were used in the Government Experiments at Penarth and Dover; also by Signor Marconi and the Wireless Telegraph Company in telegraphing to and from the Goodwin Lightship, and across the Channel; at the British Association Meeting at Dover for telegraphing to France; and at the Naval Manœuvres, where a distance of sixty miles was covered, &c.

After prolonged tests the "Apps-Newton" Coils have been adopted by the Wireless Telegraph Company, by the War Office and by the Admiralty; several have been sent to the Front in South Africa, and the ships of the Channel Squadron are now being fitted with them.

PRICES ON APPLICATION.

SOLE MAKERS:

NEWTON & CO.,

Scientific Instrument Makers to H.M. the Queen
and the Government,

3 FLEET STREET, LONDON, E.C.

GRIFFIN'S NEW FORM OF APPARATUS

For the ABSOLUTE

EXPANSION OF SOLIDS

(Weedon's Patent).



One great merit in the design of this Apparatus is that it is a purely Mechanical method, and does not depend at all upon Optical methods of magnification that so frequently are a difficulty in early Practical Physics work. The measurement reduces itself to the readings of two Micrometer Screws.

A DIRECT MECHANICAL METHOD.

ABSOLUTE READINGS OBTAINED.

SIMPLEST DESIGN.

Write for Particulars and Specimen Curves obtained.

SOLE MAKERS:

JOHN J. GRIFFIN & SONS, L^d
20-26 SARDINIA STREET, LONDON, W.C.

By the Late Dr. ST. GEORGE MIVART.

THE

GROUNDWORK OF SCIENCE.

Large 8vo, Cloth extra, 6s.

"His firm grasp of logical principles, steady insight, and clear reasonableness, eminently fit him for the task of exposing the fallacies of light scepticism, and quibbling cranks of the imagination."—*Tablet*.

"We can do little more, in the limits of newspaper space, than announce, with a cordial welcome, a new and important work by Prof. St. George Mivart. . . . This is strictly a treatise on mental science, and proves once again the philosophic power of a thinker who has done so much as an observer and as a judge of evidence."—*Weekly Register*.

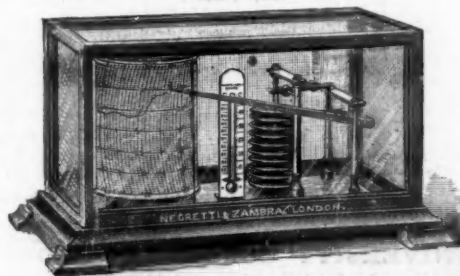
The late Dr. St. George Mivart, in a letter written a few weeks ago, said:—

"My last work, 'The Groundwork of Science,' has undergone no ecclesiastical supervision, my convictions, when I wrote it, being almost fully what they now are."

JOHN MURRAY, ALBEMARLE STREET, W.

NEGRETTI & ZAMBRA'S Self-Registering
Barometers, Thermometers and Rain Gauges.

Giving continuous Records on Charts, and only requiring attention once a week.



THE LARGE SIZE BAROGRAPH, £7 10 0

Accurate Thermometers for all purposes.

Illustrated Price List of Instruments free by post to all parts of the World.

38 HOLBORN VIADUCT, E.C.

BRANCHES—45 CORNHILL, and 122 REGENT STREET.

**ROYAL INSTITUTION OF GREAT
BRITAIN,
ALBEMARLE STREET, PICCADILLY, W.
LECTURE ARRANGEMENTS AFTER EASTER, 1900.**

LECTURE HOUR, 3 O'CLOCK P.M.

HUGH ROBERT MILL, Esq., D.Sc., LL.D., F.R.S.E., Librarian Royal Geographical Society. Three Lectures on "Studies in British Geography: (1) The English Lakes; (2) The Clyde Sea Area; (3) A Corner of Sussex. On Tuesdays, April 24; May 1, 8. Half-a-Guinea the Course.

ALEXANDER HILL, M.A., M.D., Master of Downing College, Cambridge. Two Lectures on "Brain-tissue considered as the Apparatus of Thought." (Illustrated by Photomicrographs of Brain-tissue.) On Tuesdays, May 15, 22. Half-a-Guinea.

R. WARWICK BOND, Esq., M.A. Two Lectures on (1) "Ruskin, Man and Prophet; (2) Ruskin, the Servant of Art." On Tuesdays, May 29; June 5. Half-a-Guinea.

PROF. DEWAR, M.A., LL.D., F.R.S., M.R.I., Fullerton Professor of Chemistry, R.I. Four Lectures on "A Century of Chemistry in the Royal Institution." On Thursdays, April 26; May 3, 10, 17. Half-a-Guinea.

THE REV. CANON AINGER, M.A., LL.D. Three Lectures on "Chaucer." On Thursdays, May 24, 31; June 7. Half-a-Guinea.

STANLEY LANE-POOLE, Esq., M.A. (Oxon), Professor of Arabic at Trinity College, Dublin. Two Lectures on "Egypt in the Middle Ages." On Saturdays, April 28; May 5. Half-a-Guinea.

ALFRED HILLIER, M.D., B.A. Two Lectures on "South Africa; Past and Future." On Saturdays, May 12, 19. Half-a-Guinea.

SIR FREDERICK BRIDGE, Mus. Doc., Organist of Westminster Abbey, and Gresham Professor of Music. Three Lectures on "The Growth of Chamber Music, from Allegri's Symphonias (1580-1652) to Haydn's First Quartet" (with Musical Illustrations). On Saturdays, May 26; June 2, 9. Half-a-Guinea.

Subscription (to Non-Members) to all Courses of Lectures (extending from Christmas to Midsummer), Two Guineas. Tickets issued daily at the Institution, or sent by post on receipt of Cheque or Post-Office Order.

Members may purchase not less than Three Single Lecture Tickets, available for any Afternoon Lecture, for Half-a-Guinea.

The Friday Evening Meetings will be resumed on April 27, at 9 p.m., when the RIGHT HON. LORD KELVIN will give a Discourse on "Nineteenth Century Clouds over the Dynamical Theory of Heat and Light." Succeeding Discourses will probably be given by Prof. T. E. THORPE, SIDNEY LEE, Esq., Prof. J. A. EWING, FRANCIS FOX, Esq., SIR HENRY ROSCOE, and other Gentlemen. To these Meetings Members and their Friends only are admitted.

Persons desirous of becoming Members are requested to apply to the SECRETARY. When proposed they are immediately admitted to all the Lectures, to the Friday Evening Meetings, and to the Library and Reading Rooms; and their Families are admitted to the Lectures at a reduced charge. Payment: First Year, Ten Guineas; afterwards, Five Guineas a Year; or a composition of Sixty Guineas.

**THE MIDDLESEX HOSPITAL
MEDICAL SCHOOL,**

(CLOSE TO OXFORD CIRCUS), LONDON, W.

THE SUMMER SESSION, 1900, will commence on Tuesday, May 1. Full opportunities for study are offered to Students preparing for any of the Examinations in Medicine and Surgery in the United Kingdom.

Classes will be held in the following subjects:—Midwifery, Pathology, Pathological Histology, Bacteriology, Forensic Medicine and Public Health, Anatomy, Practical Physiology and Histology, Chemistry and Practical Chemistry, Materia Medica, Therapeutics, Psychological Medicine with Clinical Demonstrations, Practical Pharmacy.

Students entering in May are eligible to compete for the Entrance Scholarships (value £100 and £60) awarded at the commencement of the ensuing Winter Session. The Broderick Scholarships, Governors' Prize, Hetley Prize, Lyell Medal, Leopold Hudson Prize, and Freeman Scholarship, are awarded annually, the Murray Scholarship (in connection with the University of Aberdeen) every third year. Eighteen resident appointments are open for competition annually, without fee.

The composition fee, admitting to the whole curriculum, is 135 guineas; if paid in three instalments, first instalment 60 guineas.

For University of London Students requiring Preliminary Science Instruction, 120 guineas, or by instalments. For members of Universities recognised by the General Medical Council, and other Students who have completed their Anatomical and Physiological studies, the fee for admission as General Students is 70 guineas, or by instalments, 75 guineas. Students from the Universities of Oxford and Cambridge entering in May are eligible to compete for the University Scholarship of £60 awarded at the commencement of the Winter Session. Fee for Dental Students, 54 guineas.

New Laboratories and Class-rooms for Physiology, Chemistry, Biology, Pathology, Bacteriology, with all modern improvements as well as a new and larger Dissecting Room and Operative Surgery Room are now in regular use.

The Residential College contains accommodation for Thirty Students. For Prospectus and further Particulars, apply to

W. PASTEUR, M.D., Dean.

**UNIVERSITY COLLEGE, LONDON.
FACULTIES OF ARTS AND LAWS AND OF SCIENCE.**

DEANS:

Professor W. P. KER, M.A., LL.D. (Arts and Laws).
Professor VAUGHAN HARLEY, M.D. (Science).

The Third Term begins Tuesday, April 24th.

For prospectus, &c., apply to

J. M. HORSBURGH, M.A., Secretary.

**ST. MARY'S HOSPITAL MEDICAL
SCHOOL,
PADDINGTON, W.**

The SUMMER SESSION will BEGIN on May 1st.

The Hospital is in close proximity to Paddington Station, Great Western Railway, to the terminus of the Great Central Railway, and to several stations of the Metropolitan and District Railways. The School provides complete preparation for the Higher Examinations and Degrees of the Universities. The Hospital affords great facilities for all branches of clinical study. The numerous clinical appointments in the Hospital are free to all students, and the resident medical appointments are awarded by competitive examination.

The NEW OUT-PATIENTS' DEPARTMENT in the Clarence Memorial Wing, with its extensive accommodation and modern equipment, possesses exceptional advantages for clinical work.

ENTRANCE SCHOLARSHIPS IN NATURAL SCIENCE.—One of £144, two of £78 15s., one of £52 10s., two of £37 15s. (for students from Oxford and Cambridge) will be awarded by Examination in September.

SPECIAL TUITION is provided for the various Examinations of the Universities of Oxford, Cambridge, and London, for the Fellowship of the Royal College of Surgeons, and for all the Final Examinations, without additional fees.

IMPROVED LABORATORIES.—The Physiological Laboratories have been further extended, and a Special Physiological Lecture Room for advanced practical classes has been added. New Pathological and Bacteriological Laboratories have also recently been provided, and the Chemical Laboratory enlarged.

PRELIMINARY SCIENTIFIC COURSE.—Special Classes, including Lectures and Laboratory Work, are held throughout the year. The prospectus, containing particulars of fees, &c., may be had on application to the Secretary.

H. A. CALEY, M.D., Dean.

GUY'S HOSPITAL MEDICAL SCHOOL.

The SUMMER SESSION will begin on May 1, and Students then entering will be eligible to compete for Entrance Scholarships of the combined value of £410 in the following September, as well as for the numerous Medals, Scholarships, and Prizes awarded during the period of Studentship.

The Hospital contains accommodation for 644 beds, and arrangements are being made as rapidly as possible to place the entire number at the service of the sick poor, by reopening the Wards that have been closed for want of funds for the last fifteen years.

The Appointments tenable by Students have recently been increased by more than 150 a year, chiefly by the addition of Clerkships and Dresserships in the departments of Ophthalmology, Gynaecology, and Otolaryngology.

To augment the teaching of special subjects, Registrars and Tutors have been appointed in the Ophthalmic and Obstetric Departments.

All Hospital Appointments are open to Students without charge, and the holders of Resident Appointments are provided with board and lodging.

The College accommodates 60 Students, under the supervision of a Resident Warden.

The Dental School provides the full Curriculum required for the L.D.S. England.

The Clubs' Union Athletic Ground is easily accessible.

A Handbook of Information for those about to enter the Medical Profession will be forwarded on application.

For the Prospectus of the School, containing full particulars as to Fees, Course of Study advised, Regulations for Residents in the College, &c., apply personally, or by letter to the DEAN, Guy's Hospital, London Bridge, S.E.

GLASGOW ROYAL INFIRMARY.

The SUMMER SESSION opens on APRIL 24, 1900. The number of beds, including the Ophthalmic Department, is 612.

Special Wards and Beds are set apart for the treatment of the Diseases of Women, of the Throat and Nose and of the Ear; and there is a specially well-equipped department for the treatment of Diseases and Injury of the Eye. Women Students are admitted to the Clinical Teaching and Practice of the Infirmary; Medical and Surgical Wards being set apart for their exclusive use.

HOUSE APPOINTMENTS.—Five House Physicians and Seven House Surgeons are elected every six months, and an Assistant to the Gynaecologist, who boards but is non-resident, is elected at the same time. Women are eligible for this appointment.

Dressers, Clinical Clerks, and Assistants to the Pathologist are selected from the Students.

BURSARIES.—The David Foulis Scholarship and the John Reid Prize, value £25 each, are open to Students of the Royal Infirmary.

Fees, which include Hospital Practice and the Clinical Lectures—for one year, £10 10s.; six months, £6 6s.; Three Months, £4 4s. The total fee is £31. Vaccination, £1 1s. Pathology, £4 4s. Bacteriology, £2 2s.

For further information apply to

M. THOMAS, M.D., Superintendent.

**THE LONDON SCHOOL OF TROPICAL
MEDICINE**

(UNDER THE AUSPICES OF HER MAJESTY'S GOVERNMENT),
CONNAUGHT ROAD, ALBERT DOCK, E.

IN CONNECTION WITH THE HOSPITALS OF THE SEAMEN'S
HOSPITAL SOCIETY.

The next SESSION commences on TUESDAY, MAY 1, 1900.

For Prospectus, Syllabus, and other particulars, apply to the Secretary, P. MICHELLI, Esq., Seamen's Hospital, Greenwich, S.E.: or to Dr. Rees, the Medical Tutor, at the School.

BARGAINS IN SCIENTIFIC BOOKS.**CAMPBELL (D. H.), THE STRUCTURE**

AND DEVELOPMENT OF THE MOSSES AND FERNS (ARCHGONIATES). By DOUGLAS HOUGHTON CAMPBELL, Ph.D. Fully Illustrated. Medium 8vo. (Pub. 14s. net.) 4s.

"Dr. Campbell's book is clearly written, well illustrated, is provided with an accurate bibliography and a copious index, so that it will take its place at once as a standard classic, and will, we think, retain that position for no considerable period."—*Gardener's Chronicle*.

BATESON (W.), MATERIAL FOR THE

STUDY OF VARIATION, treated with especial regard to Discontinuity in the Origin of Species. By WILLIAM BATESON, M.A., Fellow of St. John's College, Cambridge. 8vo, Cloth. (Pub. 21s. net.) 5s.

"The whole work must be carefully read by every serious student; and there can be no question of its great and permanent value as a contribution to our knowledge of a particular class of variations, and as a stimulus to further work in a department of knowledge which is too much neglected."—*Nature*.

HEADLEY (F. W.), THE STRUCTURE

AND LIFE OF BIRDS. By F. W. HEADLEY, M.A., F.Z.S., Assistant Master in Haileybury College. With 78 Illustrations. Crown 8vo, Cloth. (Pub. 7s. 6d.) 1s. 6d.

"We know of no book, at any rate, no modern book, which covers precisely the ground of Mr. Headley's Manual; it strengthens decidedly a weak point in Ornithological literature, and this fact, coupled with the excellence of the illustrations, should ensure for it a wide circulation."—*Ibis*.

COUES (Prof. ELLIOTT), HANDBOOK

OF FIELD AND GENERAL ORNITHOLOGY, a Manual of the Structure and Classification of Birds, with Instructions for Collecting and Preserving Specimens. Illustrated. Demy 8vo, Cloth. (Pub. 10s.) 2s. 6d.

The volume consists of two distinct parts:—PART I.—Field Ornithology contains the necessary Instructions for the Observation and Collection of Birds in the field, and for the Preparation and Preservation of Specimens for scientific study in the Cabinet. PART II.—General Ornithology is a technical Treatise of the Classification, the Zoological Characters, and the Anatomical Structure. CHAPTERS.—Implements for Collecting and their Use—Dogs—Suggestions and Directions for Field-work—Hygiene of Collectors—Registration and Labelling—Instruments—Materials and Fixtures—How to make a Bird-skin—Collection of Nests and Eggs—Care of a Collection—Definition of Birds—Principles and Practice of Classification—Definitions and Descriptions of the Exterior Parts of Birds—An Introduction to the Anatomy of Birds.

Inland Postage 3d. extra on one, or 6d. on four.

H. J. GLAISHER, New and Remainder Bookseller, 57 Wigmore Street, London, W.

Catalogues Post Free on application.

JAS. SWIFT & SON,

MANUFACTURING OPTICIANS.

SOLELY APPOINTED TO THE A.M. DEPT. WAR OFFICE, FOR THE SUPPLY OF MICROSCOPES.

Patent form of Student's Microscope, fitted with $\frac{2}{3}$ " and $\frac{1}{6}$ " Pan-Aplanatic Objectives, Iris Diaphragm and Oculars, in Case, from

£5 5s.

These Instruments we have supplied in numbers to the following Medical Schools, viz. St. Mary's, St. Bartholomew's, Guy's, Middlesex, London, and St. Thomas's.

Seven Gold Medals awarded for excellence of manufacture.

Catalogue on Application.

81 TOTTENHAM COURT ROAD, W.

LETCHER & SONS (formerly Letcher Bros.),

SCIENTIFIC INSTRUMENT MAKERS,

25 TURNPIKE LANE, HORNSEY, N.

BLOWPIPE CABINETS. SPECIALITY: SOCIETY OF ARTS SETS.

PRICE LIST, POST FREE, ON APPLICATION.

For Photography, Unsurpassed for fine definition.

COOKE LENSES

TAYLOR, TAYLOR, & HOBSON,

Stoughton Street Works, Leicester;
and 18 Berners Street, London, W.

ECLIPSE OF THE SUN.**COOK'S SELECT CONDUCTED TOURS**

TO

NAVALMORAL

Including

PARIS, BORDEAUX,
BIARRITZ, MADRID, &c.

Inclusive Fare, £30.

TO

ALGIERS,

By short Sea Route *via*
DOVER and CALAIS, including

PARIS, MARSEILLES,
ALGIERS, BLIDAH,
GORGE OF CHIFFA, &c.

Inclusive Fare, 29 Guineas.

LEAVING LONDON, MONDAY, MAY 21st.

Including First Class Rail and Steamer Tickets for the Round; First-class Hotel Accommodation; Omnibuses to and from Hotels while with the Conductors; Carriage Excursions; Fees to Hotel and Railway Servants and Admission Fees at all places of interest visited with the Conductors.

PROGRAMMES FREE ON APPLICATION.

INDEPENDENT TICKETS BY ALL ROUTES.

THOS. COOK & SON,

LUDGATE CIRCUS, LONDON,

AND BRANCH OFFICES.

C. E. MÜLLER & CO.,

SCIENTIFIC GLASS BLOWERS,

AND MANUFACTURERS OF

CHEMICAL & PHYSICAL APPARATUS,

X-Ray Tubes, Argon and Helium Spectrum Tubes.

Special Apparatus for Research, Chemical
Thermometers, &c., &c.

**NEW
GEISSLER
TUBES.**

The Flowers appearing in their
Natural Colours
under the
Kathode Rays.

PRICE £1 : 1 : 0

AN ASSORTMENT KEPT IN STOCK.

PRICE LISTS OF CHEMICAL
APPARATUS ON APPLICATION.

List of **BALANCES** also Post Free.

148 HIGH HOLBORN,
LONDON, W.C.

THE LONDON HOSPITAL MEDICAL COLLEGE.

The SUMMER SESSION commences on May 1. The Hospital is the largest in the kingdom; nearly 800 beds are in constant use, and no beds are closed. Being the only General Hospital for East London—i.e. for a million and a half people—the practice is immense. In-patients last year, 11,622; Out-patients, 178,838; Accidents, 17,370; Major Operations, 2320.

APPOINTMENTS.—Owing to the enormous number of patients, more appointments are open to Students than at any other Hospital. Sixty qualified appointments are made annually, and more than 150 Dressers, Clinical Clerks, &c., appointed every three months. All are free to Students of the College. Holders of Resident Appointments have Free Board.

SCHOLARSHIPS AND PRIZES.—Twenty-seven Scholarships and Prizes are given annually. Students entering in May can compete for five Entrance Scholarships in September.

Special arrangements have been made to enable Students entering in May to present themselves for examination in Chemistry, &c., in July.

SPECIAL CLASSES are held for the University of London and other higher examinations. Special entries for Medical and Surgical Practice can be made. Qualified Practitioners will find excellent opportunities for studying the rarest diseases.

A reduction of 15 Guineas is made to the Sons of Members of the Profession. ENLARGEMENT OF THE COLLEGE.—The new Laboratories and Class-rooms for Bacteriology, Public Health, Operative Surgery, Chemistry, Biology, &c., have now been added, with all modern improvements.

The Clubs' Union Athletic Ground is within easy reach of the Hospital. The Metropolitan and other Railways have Stations close to the Hospital and College.

For Prospectus and information as to Residence, &c., apply personally, or by letter, to

MUNRO SCOTT, Warden.

Mill End, E.

THE ZOOLOGICAL SOCIETY OF LONDON.

Four Zoological Lectures will be delivered in the Society's Meeting-room, at 3 Hanover Square, W., on Thursdays at 4.30 p.m. (after the General Meetings), on April 19, May 17, June 21, and July 19, as follows:—

Date.	Subject.	Lecturer.
Thursday, April 19.	The Animals of Australia.	Mr. A. SMITH WOODWARD, F.Z.S.
" May 17.	The Freshwater Fishes of Africa.	Mr. G. A. BOULENGER, F.R.S., F.Z.S.
" June 21.	The Gigantic Sloths of Patagonia.	Prof. E. RAY LANKESTER, F.R.S., F.Z.S.
" July 19.	Whales.	Mr. F. E. BEDDARD, F.R.S., F.Z.S.

Tickets for these Lectures may be obtained at the Society's Office, price 2s. 6d. each Lecture. Fellows of the Society can obtain Free Tickets for themselves and two friends on application.

SCIENCE AND ART EXAMS.

LONDON AND SOUTH KENSINGTON.

Oral or Correspondence Preparation by SPECIALIST TUTORS.

New and Perfected System of Correspondence Tuition. WORKSHEETS A SPECIALITY, saving Time and Trouble.

Address:—

JOHN GIBSON, M.A., 24 CHANCERY LANE, W.C.

BLACKBURN MUNICIPAL TECHNICAL SCHOOL.

Applications are invited for the position of SECOND ASSISTANT LECTURER in the Physics and Electrical Engineering Department, for next Session. The duties include part of the Physics teaching in the Day School, and some evening work. Salary, £100 per annum.

Applications should be sent in not later than April 28th, to the undersigned, from whom further particulars may be obtained.

A. W. KING, Secretary.

SCIENCE EXAMINATIONS.

For LONDON and other UNIVERSITIES, the CONJOINT BOARD, &c.

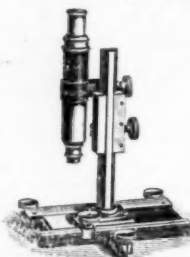
Well-equipped LABORATORIES, DAY AND EVENING. Personal or Class Tuition.

"R.," 9 Heathcote Street, Gray's Inn Road, W.C.

Partner Wanted in a Scientific Manufacturing Business, with £1000 or upwards. Would suit Scientific Man or Son; exceptional opening; Capital wanted to carry out the Orders open, and—by enlarging Business—to avail of greatly increased trade waiting. Profits very large.—Address, "Scientific," care of NATURE Office.

W. WILSON.

VERNIER MICROSCOPE.



Horizontal and Vertical Scales; 16 cm. in length. The microscope rotates on a horizontal axis, and can be clamped in any position. One power and one Eye-piece.

With Scales reading to 1 mm. £6 10

" " "05 " 7 0

" " "02 " 7 10

" " "01 " 8 5

1 BELMONT STREET, CHALK FARM, N.W.

CARL ZEISS, OPTICAL WORKS, JENA.
ASTRONOMICAL DEPARTMENT.



Binary Apochromatic Telescope Object-Glasses, free from Secondary Spectrum, for Visual purposes. Aperture from 1.7 to 1.20.

Triple Photo-Visual Object-Glasses, free from Secondary Spectrum and Differences in Focus, for Observation and Photography. Aperture 1.10 to 1.15.

Apochromatic Aplanatic Object-Glasses, with reduced Secondary Spectrum, for Astro-Photography.

Achromatic Eye-Pieces, with long Eye-Distance.


Telescope Object-Glasses made of ordinary Silicate Glasses.

Objectives, Prisms, Eye-Pieces, and all Astronomical Accessories.

Complete Mounts for Telescopes in any desired form and size.

Special Astronomical Catalogue, in German, French or English, free on application.

London Branch: 29 Margaret Street, Regent Street, W.



C. BAKER,

MICROSCOPE MANUFACTURER.

CATALOGUE 1899-1900

Post Free to readers of this Journal. Apply—

244 HIGH HOLBORN, W.C.

EVERETT & CO.,

Mechanical Engineers and Electricians,

22 CHARTERHOUSE SQUARE, E.C.

MAKERS OF HIGH-GRADE

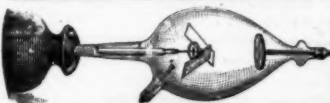
PHYSICAL & ELECTRICAL APPARATUS.

Apparatus designed and made for Laboratories and Research Work.

ALL KINDS OF EXPERIMENTAL WORK.

Our List is now ready, and may be had post free on application.

See "Notes" in NATURE, March 15, 1900.



GLASS BLOWING

GEISSLER TUBES IN BEAUTIFUL DESIGNS.

TUBES containing specimens of Fluorescent and Phosphorescent Minerals, Salts, Rubies, &c.

ILLUSTRATED TUBE contains Vanes which Fluoresce in three brilliant colours, and revolve by means of Cathode Rays.

GOSSOR, 67 FARRINGDON ROAD, E.C.

New Design in Galvo. Lamp and Scale.

Second Volume.

A SELECTION OF PHOTOGRAPHS OF STARS, STAR CLUSTERS, AND NEBULÆ,

Together with Information concerning the Methods employed in the Pursuit of
Celestial Photography (Illustrated by 72 Photographs reproduced in Collotype),

By **ISAAC ROBERTS, D.Sc., F.R.S.**

Now Ready. Royal Quarto. Price **30s.**, post free.

LONDON: KNOWLEDGE OFFICE, 326 HIGH HOLBORN, W.C.

THE GEOGRAPHICAL JOURNAL.

Price 2s. CONTENTS.—APRIL.

A Bathymetrical Survey of the Freshwater Lochs of Scotland. By Sir John Murray, K.C.B., and Fred P. Pullar, Esq., F.R.G.S.
A Fragment of the Geography of England—South-West Sussex. By Hugh Robert Mill, D.Sc., LL.D.
New Light on some Mediaeval Maps. By C. Raymond Beazley, M.A.
Moore's Expedition of Tanganyika.
The Ruined Cities of Central America—Review. By Colonel G. E. Church.
Narrative of a Journey to the Lakes Rakas-Tal and Manasarovar, in Western Tibet. By Lieut.-General Sir Richard Strachey, K.E., G.C.S.I.
The Date Line in the Pacific.
The Monthly Record.
Obituary: Admiral Somerset; Dr. Friedrich Jagor.
Correspondence: Fish in Frozen Rivers and Lakes. By Surgeon-Major Geo. Henders n
Meetings of the Royal Geographical Society, Session 1899-1900.
Geographical Literature of the Month
Numerous Maps and Illustrations.

EDWARD STANFORD, 26-27 Cockspur Street, Charing Cross, S.W.

Now Ready. 8vo. Price **4s. net.**

INORGANIC EVOLUTION

AS STUDIED BY
SPECTRUM ANALYSIS.

BY

SIR NORMAN LOCKYER, K.C.B., F.R.S.

MACMILLAN AND CO., LTD., LONDON.

On the OCCURRENCE of CYANOGEN
COMPOUNDS in COAL-GAS, and of the SPECTRUM of CYANOGEN in that of the Oxy-Coal-Gas Flame.

By **W. N. HARTLEY, F.R.S.,**

Royal College of Science, Dublin.

Being the Scientific Proceedings of the Royal Dublin Society, Vol. IX. N.S. Part 3, No. 19. Price Sixpence.

WILLIAMS & NORGATE, 14 Henrietta Street, W.C.

NOW READY.

Tenth Edition. Illustrated with numerous Plates and Diagrams.
Pp. 502. Cr. 8vo. Cloth, 6s. net.

INSTRUCTION IN PHOTOGRAPHY.

BY

Sir W. de W. ABNEY, K.C.B., D.C.L., F.R.S.

Revised and greatly enlarged, bringing the book up to date, and including additional chapters on Photo-block Work, Three-colour Work, Hand Camera and Film Photography, Paper Processes, New Developers, &c., &c.

LONDON: SAMPSON LOW, MARSTON & COMPANY, Limited,
St. Dunstan's House, Fetter Lane, Fleet Street, E.C.

NATURE PRINTING IN COLOURS.

LEPIDOPTERA.

The Colours, Tints, and Shades of the Wings are true to Nature and as perfect as if Photographed in Colours (were this possible). They are done by a secret process, and scarcely distinguishable from the real insect.
1 Specimen, 1s. 6d.; ½ doz., 8s.; 1 doz., 15s.; remittance with order.—
BERNARD PIFFARD, Hemel Hempstead, Herts.

Sale by Auction.

MONDAY, APRIL 23.

THE REMAINING PORTION OF THE "SAMUEL STEVENS" COLLECTION.

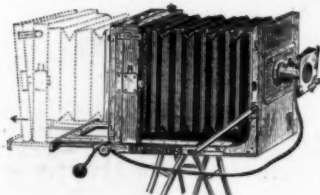
MR. J. C. STEVENS will Sell by Auction,
at his Great Rooms, 38 King Street, Covent Garden, on Monday, April 23, the remaining portion of the well-known Collection of British Lepidoptera formed by the late SAMUEL STEVENS, Esq., F.R.S., F.L.S., comprising the Micro-Lepidoptera, the Supplementary Series of Macros and the Duplicates, together with the Cabinets, Books, &c., appertaining to the Collection.

On View Saturday prior, from 10 till 4, and Morning of Sale. Catalogues on application, post free.

TRADE
MARK

"OPTIMUS."

TELEGRAPHIC
ADDRESS.



**PHOTOGRAPHIC
APPARATUS**
OF BEST WORKMANSHIP
FOR ALL PURPOSES.



Catalogue POST FREE.

PERKEN, SON & CO., LTD., 99, HATTON GARDEN, HOLBORN CIRCUS, E.C. **LONDON.**

A. AND C. BLACK'S LIST.

A TREATISE ON ZOOLOGY.

By E. RAY LANKESTER, M.A., LL.D., F.R.S., Hon. Fellow of Exeter College, Oxford; Director of the Natural History Departments of the British Museum; Fullerian Professor of Physiology and Comparative Anatomy in the Royal Institution of London. Profusely Illustrated. To be completed in Ten Parts. NOW READY. Part III. THE ECHINODERMA. By F. A. BATHER, M.A., assisted by J. W. GREGORY, D.Sc., and E. S. GOODRICH, M.A. Demy 8vo, paper covers, price 12s. 6d net; cloth, price 15s. net.

"It is marked by three characteristics, which indeed may be regarded as now indispensable to any scientific work of value—perfect lucidity in the illustrations, which are numerous, and, of course, specially drawn by, or under the direction of, the author; a careful exposition of the historical development of life-forms; and complete biographies on each branch of the subject."—*Literature*.

NOW READY. Demy 8vo, cloth, price 12s. 6d. net.

SEXUAL DIMORPHISM IN THE ANIMAL KINGDOM.

A Theory of the Evolution of Secondary Sexual Characters. By J. T. CUNNINGHAM, M.A. Containing 32 Illustrations.

"Mr. Cunningham has elaborated a theory of evolution in answer to the problem: What are the causes which have produced the three kinds of structural difference in animals? He supports his theory by facts and illustrations drawn mainly from the works of others. A book of distinct scientific importance. The present volume is well printed and profusely illustrated with carefully executed figures."—*The Outlook*.

NOW READY. Crown 8vo, cloth, price 3s. 6d.

INTRODUCTION TO STRUCTURAL BOTANY.

Part II. Flowerless Plants. Third Edition. By D. H. SCOTT, M.A., Ph.D., F.R.S., Honorary Keeper of the Jodrell Laboratory, Royal Gardens, Kew.

"It stands out from the ever-increasing crowd of guides, text-books, and manuals, in virtue not only of originality of design, but also of the fact that the subjects treated have been specially investigated for the purpose of the book, so that we have not the mere compilation of a book-man, but an account based on the results of the author's own observation."—*Natural Science*.

NOW READY. Post 8vo, cloth, price 12s. 6d.

ALGEBRA. An Elementary Text-book for the Higher Classes of Secondary Schools and Colleges. Part II. Second Edition. By Prof. GEORGE CHRYSAL, M.A., LL.D.

"The merits of the work are so well known that it is unnecessary to do more than announce the publication of the new edition."—*Nature*.

NOW READY. Demy 8vo, cloth, price 7s. 6d. net.

THE GRAMMAR OF SCIENCE.

By KARL PEARSON, M.A., F.R.S., Professor of Applied Mathematics and Mechanics in University College, London. Second Edition, thoroughly Revised and much Enlarged. Contains Two entirely New Chapters on Natural Selection and Heredity, embracing a Popular Account of Prof. Pearson's own more recent work in this direction. Containing 33 Illustrations in the Text.

"It is still a grammar in that it deals with the foundations of science; but a far more ambitious title might have been given to so comprehensive a work."—*The Bookman*.

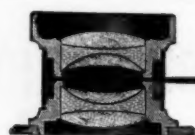
NOW READY. Demy 8vo, cloth, price 10s. 6d.

TEMPERATE CHILE: a PROGRESSIVE SPAIN.

By W. ANDERSON SMITH, formerly Special Commissioner to the Chilean Government to Report on their Rivers.

"The book is both charming and valuable."—*Nature*.

A. AND C. BLACK, SOHO SQUARE, LONDON.



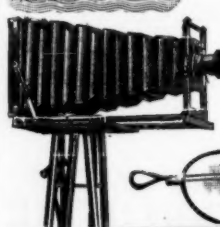
ROSS, Ltd.,

Manufacturers of Celebrated
ROSS' PORTRAIT AND VIEW LENSES
ROSS-ZEISS' ANASTIGMATIC LENSES
ROSS-GOERZ' DOUBLE ANASTIGMATS
ROSS' NEW HAND-CAMERA LENSES
ROSS' FIELD AND STUDIO CAMERAS
ROSS' SPECIAL HAND CAMERAS
ROSS' NEW ENLARGING LANTERNS
ROSS' PATENT SCIENCE LANTERNS
ROSS' NEW ECLIPSE MICROSCOPES
ROSS' IMPROVED TELESCOPES
ROSS' FIELD AND OPERA GLASSES
ROSS' NEW PRISMATIC BINOCULARS
&c., &c., &c.

ROSS, Ltd.,

(ESTAB. 1830.)

MANUFACTURING OPTICIANS,
111 NEW BOND ST., LONDON, W.,
AND
31 COCKSPUR ST., CHARING
CROSS, S.W.



IMPROVED D'ARSONVAL GALVANOMETERS.

PRICES

£10-0-0

AND

£4-10-0

LIBERAL DISCOUNTS.

Most
SENSITIVE
for
DEFLECTIVE,
ZERO,
or
BALLISTIC
WORK.



Write for Price List and Particulars of Potentiometers, Galvanometers, Electrical Thermometers, Experimental Direct and Alternating Current Sets, &c., to

CROMPTON & CO., LD.,

Laboratory { "THRIPLANDS," } LONDON, W.
KENSINGTON COURT,

GRIFFIN'S METALLURGICAL SERIES.

Edited by Sir W. C. ROBERTS-AUSTEN.

NOW READY. Illustrated, Cloth, Price 16s.

SILVER,
BEING PART II. OF
THE METALLURGY OF LEAD AND SILVER.

BY

H. F. COLLINS, A.R.S.M.

Complete in itself, and sold separately.

CONTENTS:—

Properties of Silver and its Principal Compounds.—Silver Ores.—The Patio Process.—The Kayo, Fondon, Kröbuke and Tina Processes.—The Pan Process.—Roast Amalgamation.—Treatment of Tailings and Concentrates.—Retorting, Melting, and Assaying.—Chloridising—Roasting.—The Augustin, Claudet, and Ziervogel Processes.—The Hyposulphite Leaching Process.—Refining.—Matte Smelting in Blast Furnaces.—Pyritic Smelting.—Matte Smelting in Reverberatories.—Silver-Copper Smelting and Refining.—INDEX.

Already Issued, uniform with above, Price 16s.

Part I., **LEAD.** A Treatise on the Manufacture of Lead, and on Smelting, Desilverisation, Assay, and Analysis.

NOW READY. With Frontispiece, Plans, and Illustrations, Price 6s.

THE

CYANIDE PROCESS OF GOLD EXTRACTION.
A TEXT-BOOK FOR THE USE OF MINING STUDENTS,
METALLURGISTS, AND CYANIDE OPERATORS.

BY

JAMES PARK, F.G.S., M.Inst.M.M.,

Late Director, Thames School of Mines, and Geological Surveyor and Mining Geologist to the Government of New Zealand.

First English Edition, thoroughly Revised and greatly Enlarged from the Third Edition (published in New Zealand). With additional details concerning the Siemens-Halske, and other recent Processes of Extraction.

LONDON: CHARLES GRIFFIN & Co., LTD.,
EXETER STREET, STRAND.**E. LEYBOLD'S NACHFOLGER,**SCIENTIFIC INSTRUMENT
MAKERS,
COLOGNE (GERMANY).

New Catalogue of Physical Apparatus,
containing 3400 numbers and 1200 illustrations,
sent on application.

DUDELL
OSCILLOGRAPH.An Invaluable Instrument for
Alternate Current Work.

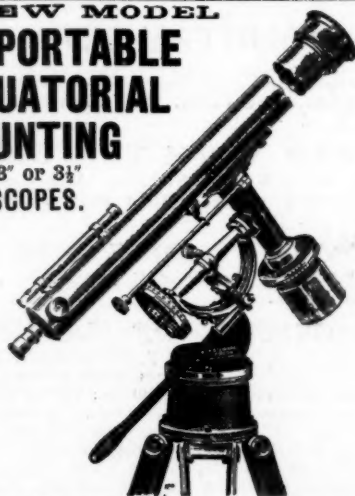
This Galvanometer has the shortest
periodic time of any Instrument
yet constructed, viz. 0.0001 Second,
is perfectly dead-beat, and the self-
induction is practically nil.

WRITE FOR DESCRIPTIVE PAMPHLET.

SOLE MAKERS—

SCIENTIFIC INSTRUMENT CO.
LIMITED,**CAMBRIDGE.**

NEW MODEL

PORTABLE
EQUATORIAL
MOUNTINGFor 3" or 3½"
TELESCOPES.

Latitude Adjustment, Clamp for Declination Axis, Quick and Slow Motion, in Right Ascension.

EQUATORIAL MOUNTING with Divided Circles and Stand
fitted with short Iron Column, Levelling Screws, and Metal
Stretchers, £15 15s.; or, complete with 3" Telescope, £25.

ILLUSTRATED CATALOGUE GRATIS.

J. H. STEWARD,
OPTICIAN,406 STRAND, 457 WEST STRAND,
7 GRACECHURCH STREET, LONDON.

MACMILLAN & CO.'S BOOKS FOR THE SPRING.

THE GARDEN.

21ST THOUSAND.
ELIZABETH and her GERMAN GARDEN. Extra crown 8vo, 6s.

11TH THOUSAND.
THE SOLITARY SUMMER.
By the same Author. Extra crown 8vo, 6s.

THE BOOK OF THE ROSE.
By Rev. A. FOSTER-MELLIAR, M.A. Illustrated.
Extra crown 8vo, 8s. 6d. net.

GARDEN MAKING. Suggestions
for the Utilisation of Home Grounds. By L. H.
BAILEY. Globe 8vo, 4s. net.

GARDEN FLOWERS AND PLANTS. A Primer for Amateurs. By J. WRIGHT,
F.R.H.S. With 50 Illustrations. Pott 8vo, 1s.

A YEAR IN A LANCASHIRE GARDEN. By HENRY A. BRIGHT. Crown 8vo,
3s. 6d.

THE ENGLISH FLOWER GARDEN. By HENRY A. BRIGHT. With illus-
trative notes. Crown 8vo, 3s. 6d.

THE COUNTRY-SIDE.

TALES OF THE BIRDS. By
W. WARDE FOWLER, M.A. Illustrated. Crown
8vo, 3s. 6d.

A YEAR WITH THE BIRDS.
By W. WARDE FOWLER, M.A. With Illustrations
by BRYAN HOOK. Third Edition. Enlarged.
Crown 8vo, 3s. 6d.

**SUMMER STUDIES OF BIRDS
AND BOOKS.** By W. WARDE FOWLER, M.A.
Crown 8vo, 6s.

CURIOSITIES OF NATURAL HISTORY. By FRANCIS T. BUCKLAND. Popular
Edition, with a few Illustrations. Each series separately,
in small 8vo, price 2s. 6d. as follows: **FIRST SERIES**
—Rats, Serpents, Fishes, Frogs, Monkeys, &c. **SECOND SERIES**—Fossils, Bears, Wolves, Cats,
Eagles, Hedgehogs, Eels, Herrings, Whales. **THIRD SERIES**—Wild Ducks, Fishing, Lions, Tigers, Foxes,
Porpoises. **FOURTH SERIES**—Giants, Mummies,
Mermaids, Wonderful People, Salmon, &c.

ROUND THE YEAR. A Series
of Short Nature Studies. By Prof. L. C. MIALI,
F.R.S. With Illustrations, chiefly by A. R. HAM-
MOND, F.L.S. Crown 8vo, 5s.

MADAME HOW AND LADY WHY; or First Lessons in Earth-lore for Children. By
CHARLES KINGSLEY. Crown 8vo, 3s. 6d.

THE COUNTRY-SIDE—(continued.)

**AMONG ENGLISH HEDGE-
ROWS.** Written and Illustrated by CLIFTON
JOHNSON. Extra Crown 8vo, gilt top, 8s. 6d. net.

**NATURAL HISTORY AND
ANTIQUITIES OF SELBORNE.** By GILBERT
WHITE, with Notes by FRANK BUCKLAND, a
Chapter on Antiquities by Lord SELBORNE, and new
Letters. Illustrated. Crown 8vo, 6s.

**FORTY YEARS IN A MOOR-
LAND PARISH.** Reminiscences and Researches in
Danby-in-Cleveland. By the late CANON ATKIN-
SON, D.C.L. With Maps and Illustrations. Extra
crown 8vo, 5s. net. Illustrated Edition, 12s. net.

HIGHWAYS & BYWAYS.

NORMANDY. By PERCY
DEARMER, M.A. Illustrated by JOSEPH PEN-
NELL. Extra crown 8vo, 6s. [*Just ready.*]

DONEGAL, &c. By STEPHEN
GWYNN. Illustrated by HUGH THOMSON. Extra
crown 8vo, 6s.

YORKSHIRE. By ARTHUR H.
NORWAY. Illustrated by JOSEPH PENNELL and
HUGH THOMSON. Extra crown 8vo, 6s.

NORTH WALES. By A. G.
BRADLEY. Illustrated by HUGH THOMSON and
JOSEPH PENNELL. Extra crown 8vo, 6s.

DEVON AND CORNWALL.
By A. H. NORWAY. Illustrated by JOSEPH
PENNELL and HUGH THOMSON. Extra crown
8vo, 6s.

MR. HISSEY'S ROAD BOOKS.

OVER FEN and WOLD. With
Fourteen Full-page (and some smaller) Illustrations.
Demy 8vo, 16s.

**ON SOUTHERN ENGLISH
ROADS.** With Illustrations. Demy 8vo, 16s.

**THROUGH TEN ENGLISH
COUNTIES.** With Illustrations. Demy 8vo, 16s.

**ACROSS ENGLAND in a DOG-
CART:** from London to St. David's and Back. With
Illustrations. Demy 8vo, 16s.

**AN OLD-FASHIONED
JOURNEY IN ENGLAND AND WALES.** Demy
8vo, with Frontispiece, 12s.

A HOLIDAY ON THE ROAD.
An Artist's Wanderings in Kent, Sussex, and Surrey.
With Illustrations. Demy 8vo, 16s.

MACMILLAN AND CO., LIMITED, LONDON.

MACMILLAN & CO.'S NEW SCIENTIFIC BOOKS.

MICRO-ORGANISMS AND FERMENTATION.

By ALFRED JÖRGENSEN,

Director of the Laboratory for the Physiology and Technology of Fermentation at Copenhagen. Translated by ALEX. K. MILLER, Ph.D., F.I.C., and A. E. LENNHOLM. Third Edition, completely Revised. With 83 Illustrations. 8vo. 10s. net.

AN ELEMENTARY COURSE OF PRACTICAL ZOOLOGY.

By the late T. JEFFERY PARKER, D.Sc., F.R.S., Professor of Biology in the University of Otago, Dunedin, New Zealand, and W. NEWTON PARKER, Ph.D., Professor of Zoology at the University College of South Wales and Monmouthshire, in the University of Wales. With 156 Illustrations. Crown 8vo. 10s. 6d.

LANCET.—"Will be found serviceable to the upper classes of schools where natural history is taught, and to classes for elementary biology in medical schools."

A MANUAL OF ZOOLOGY.

By the late Prof. T. J. PARKER, D.Sc., F.R.S., and Prof. W. A. HASWELL, M.A., D.Sc., F.R.S. With Three Hundred Illustrations. Crown 8vo, 10s. 6d.

ZOOLOGIST.—"The present publication may be considered a condensation of the previous work ('A Text-Book of Zoology'). . . . Thus we have the essence of a really good book in a convenient form for teachers and students."

KNOWLEDGE.—"The text is accompanied by about three hundred beautiful illustrations. . . . The treatment is explicit throughout, and the book is sure to gain a wide popularity."

ENLARGED AND REVISED EDITION NOW READY.

LESSONS IN ELEMENTARY PHYSIOLOGY.

BY THOMAS H. HUXLEY, LL.D., F.R.S.

Enlarged and Revised Edition. Globe 8vo. 4s. 6d.

TEXT-BOOK OF PALÆONTOLOGY.

By KARL A. VON ZITTEL,

Professor of Geology and Palæontology in the University of Munich. Translated and Edited by CHAS. R. EASTMAN, Ph.D., Assistant in Palæontology in the Museum of Comparative Zoology at Harvard. With 1476 Woodcuts. Medium 8vo. 25s. net.

* * This English Edition is revised and enlarged by the Author and Editor in collaboration with numerous Specialists.

SPEAKER.—"A most valuable addition to the scientific literature of the world, and the publication of the second volume, dealing with the Vertebrata, will be awaited with the keenest interest on all sides."

THE PRINCIPLES OF MECHANICS PRESENTED IN A NEW FORM.

By HEINRICH HERTZ, late Professor of Physics in the University of Bonn. With an Introduction by H. VON HELMHOLTZ. Authorised English Translation by D. E. JONES, B.Sc., District Inspector under the Department of Science and Art, &c., and J. T. WALLEY, M.A. 8vo. 10s. net.

ENGINEER.—"A very remarkable book. . . . A book which it is impossible to pass over in silence, fraught as it is with infinite possibilities of the future. It represents the latest work of one of the finest intellects of the century."

INTRODUCTION TO PHYSICAL CHEMISTRY. By JAMES WALKER, D.Sc.,

Ph.D., Professor of Chemistry in University College, Dundee. 8vo. 10s. net.

LANCET.—"The book is written in such a lucid way as to render its perusal free from that irksomeness which is so often the student's experience when confronted with theoretical considerations. The book should serve as an admirable introduction to more advanced works."

NOW COMPLETE IN THREE VOLS.

DICTIONARY OF POLITICAL ECONOMY. Edited by R. H. INGLIS PALGRAVE.

Medium 8vo. 21s. net each.

ECONOMIC JOURNAL.—"The list of contributors is a brilliant one. They have played their parts well, and the editor has managed them with great ability. . . . If its success is at all commensurate with its deserts, the publishers may congratulate themselves upon a very valuable venture. No working economist can afford to be without this dictionary. Mr. Palgrave's dictionary emerges successfully from the severe test of comparison with its French and German predecessors."

A DIVIDEND TO LABOUR. A Study of Employers' Welfare Institutions. By

NICHOLAS P. GILMAN. Crown 8vo. 7s. 6d.

MAN AND HIS ANCESTOR. A Study in Evolution. By CHARLES MORRIS.

Globe 8vo. 5s.

THE FARMSTEAD. The Making of the Rural Home and the Lay-out of the

Farm. By Prof. I. P. ROBERTS. Illustrated. Globe 8vo. 4s. 6d. net.

[The Rural Science Series.]

MACMILLAN AND CO., LIMITED, LONDON.

WATKINS & DONCASTER,
NATURALISTS,
AND MANUFACTURERS OF
CABINETS AND APPARATUS
FOR ENTOMOLOGY, BIRDS' EGGS, AND ALL BRANCHES OF
NATURAL HISTORY.

SPECIAL SHOW-ROOM FOR CABINETS.

Call or send for detailed Catalogue (66 pp.), Post free on application.

N.B.—For Excellence and Superiority of Cabinets and Apparatus, references are permitted to distinguished patrons, Museums, Colleges, &c.

A LARGE STOCK OF INSECTS AND BIRDS' EGGS.

Birds, Mammals, &c., Preserved and Mounted by First-class Workmen with true natural surroundings. All Books and Publications on Natural History supplied.

36 STRAND, LONDON, W.C.
(Five Doors from Charing Cross.)

MINERALS, ROCKS & FOSSILS.

COLLECTIONS FOR STUDENTS.

Carefully labelled and arranged in Boxes with Card Trays.

50 Minerals, 12/6; 100 do., 21/; 200 do., 42/.

Rocks and Fossils at similar prices.

300 Minerals in Cabinet, £4 4s.; 400 do., £5 12s. 6d.

Catalogues Post Free.

THOMAS D. RUSSELL,
78 NEWGATE STREET, LONDON, E.C.

PHŒNIX FIRE OFFICE,

9 LOMBARD ST., E.C., and 57 CHARING CROSS, S.W.

ESTABLISHED 1782.

MODERATE RATES. ABSOLUTE SECURITY.

ELECTRIC LIGHTING RULES SUPPLIED.

LIBERAL LOSS SETTLEMENTS.

PROMPT PAYMENT OF CLAIMS.

FRANCIS B. MACDONALD, SECRETARY.

LOSSES PAID OVER £22,000,000.

ESTABLISHED 1851.

BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

INVESTED FUNDS

£10,000,000.

The BIRKBECK ALMANACK, with full particulars, post free.

FRANCIS RAVENSCROFT, Manager.

T. TAMBLYN-WATTS,
SCIENTIFIC APPARATUS MAKER.

Catalogue of Electrical Apparatus and Materials, 6d. Post free.

Catalogue of Balances and Weights, Apparatus for the Study of Mechanics, &c., 6d. Post free.

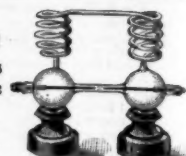
GOLDIELANDS, SETTLE, YORKS.

GLASS BLOWING.

All kinds of Experimental Glass
Blowing carried out for Scientific
Men, Laboratories, &c.

INVENTORS' IDEAS WORKED OUT AS PER INSTRUCTIONS.

COSSOR,
67 Farringdon Road, E.C.



Hittorf's Tube showing the resistance of the dark space.

SECOND-HAND MICROSCOPES

By SWIFT, WATSON, CROUCH, BECK, ZEISS, LEITZ, &c.
Prices from £2 10s. to £45.

A Large Selection of Second-hand Powers and Fittings for all kinds of Microscopes.

Send for New List.

CLARKSON & CO., 28 Bartlett's Buildings, Holborn Circus, E.C.

TO SCIENCE LECTURERS.

HUGHES' MOTO-PHOTOSCOPE FOR LIVING PICTURES.

THE MOST PERFECT.

No SHUTTER, therefore no Flickering. Superb Mechanism.

The Moto-Photo Camera for taking the Pictures. Illustrated Lists, 2d.

See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN &c. Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great success. New Oxyhydrogen Microscope. Science Lanterns for Class Demonstration. Magnificent Results. Docwra Triple, Prize Medals Highest Award. Supplied to the Royal Polytechnic Institution, Dr. H. GRATTAN GUINNESS, Madame ADELINA PATTI, &c., &c. Patent Pamphongo, Science Lanterns. The Universal Lantern 4-inch Condensers, 4-wick Lamp, Portrait Combination front Lenses, 18s. 6d., Marvellous value. Science Lecture Sets. Novelities. The Lantern Kaleidoscope. Cheapest Lantern Outfits in the World. Grandly Illustrated Catalogue, over 180 choice Engravings, 6d.; Postage, 3d. List of 300 Lecture Sets, Science Subjects, Views, &c., 6d.; Postage 2d. Pamphlets Free. W. C. HUGHES, SPECIALIST, Brewster House, 8a Mortimer Road, Kingsland, N.

ALBERT EDWARD JAMRACH

(Late CHARLES JAMRACH),
NATURALIST,

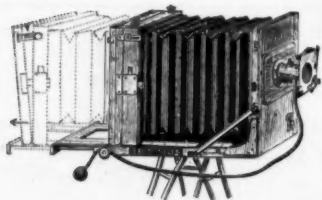
180 ST. GEORGE STREET EAST.

Implements of Savage Warfare, Idols, Sacred Masks, Peruvian Pottery, Netsukis China, Lacquers, Gongs, Shells, and other Curios.

TRADE
MARK

"OPTIMUS."

TELEGRAPHIC
ADDRESS.



**PHOTOGRAPHIC
APPARATUS**

OF BEST WORKMANSHIP
FOR ALL PURPOSES.

Catalogue POST FREE.



PERKEN, SON & CO., LTD., 99, HATTON GARDEN, HOLBORN CIRCUS, E.C. **LONDON.**

MOORE'S HYDROSTATIC BALANCE



FOR ILLUSTRATING THE "PRINCIPLE OF ARCHIMEDES" AND SPECIFIC GRAVITY.

A is a delicate spring balance accurately graduated to read Grams, and is capable of being lowered or raised by the string shown.

B is one of the set of cubes of various metals supplied with the apparatus.

C is a glass vessel with fixed mark etched in glass, up to which water, or other liquid, is placed. The vessel is provided with draw-off cock.

Sole Makers of this Apparatus—

BREWSTER, SMITH, & CO.,

6 CROSS STREET, FINSBURY, E.C.

Manufacturers and Importers of Chemical and Scientific Apparatus and Pure Chemicals.

WEIGHTS a Speciality, 500 Milligrams to 1 Milligram, 1s. 6d. per doz.

SEND FOR COMPLETE ILLUSTRATED CATALOGUE.

CARL ZEISS,

MANUFACTURER OF

MICROSCOPES; TELESCOPES (ASTRONOMICAL and TERRESTRIAL); PRISM FIELD GLASSES; TELEMETERS; PHOTOGRAPHIC OBJECTIVES; and OPTICAL MEASURING INSTRUMENTS, including COMPARATORS, REFRACTOMETERS, BUTTER-REFRACTOMETERS, SPECTROMETERS, &c.

LONDON BRANCH:

29 MARGARET ST., CAVENDISH SQUARE, W.

Telegrams:—DIACTINIC, London.

CATALOGUES POST FREE. KINDLY SAY WHICH REQUIRED.

Apparatus for estimation of sulphur in spent oxide.



FREDK. JACKSON & Co.

(Late MOTTERHEAD & CO.),

14 CROSS STREET, MANCHESTER.

Goods Entrance: 10 Half-Moon Street,

LABORATORY FURNISHERS,

Importers, Manufacturers, and Dealers in

CHEMICAL AND PHYSICAL APPARATUS

Of every Description.

Fine Chemicals, Volumetric Solutions, Plain and Stoppered Bottles,

AND EVERY LABORATORY REQUIREMENT.

Illustrated Catalogue of Apparatus, with Price List of Chemicals, free on application.

Telegraphic Address—"APPARATUS, MANCHESTER."

Telephone Number—2038.

SOLAR AND STELLAR SPECTROSCOPES.

Evershed's Solar Spectroscopes (specially Designed by J. EVERSHED, F.R.A.S., for the Observation of Solar Protuberances.)

Disc Prisms, for Use in Front of a Telescope

Object-Glass for Stellar Spectroscopy and Eclipse Work.

And all other requirements for Celestial Spectroscopy.

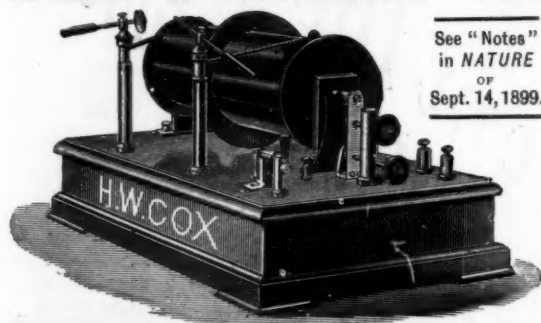
FOR THE ECLIPSE. Film reproductions of

ROWLAND'S Gratings adapted to Hand Telescopes or Binoculars of any kind, for Observation of the Sun at the Flash Point. The Spectrum from A to H is more than 20". The Grating is on a Prism, which is Mounted in a Cap with Eyehole, which can be put on or taken off in an instant.

PRICE from 35s.

ADAM HILGER, 204 Stanhope St., London, N.W.

X-RAY & ÆTHERIC TELEGRAPHY APPARATUS



See "Notes" in NATURE

OF Sept. 14, 1899.

OF THE HIGHEST QUALITY AND FINISH ONLY,

As supplied by us to H.M. Government and the leading Hospitals and X-Ray Workers throughout the World.

We are the actual Manufacturers, and Guarantee every Coil against breaking down.

CALL OR WRITE FOR OUR NEW ILLUSTRATED LIST, WITH TESTIMONIALS AND ILLUSTRATED INSTRUCTIONS UPON HOW TO WORK. POST FREE TO READERS OF "NATURE."

HARRY W. COX, Ltd.,

10, 11, 28 CURSITOR STREET,

CHANCERY LANE, LONDON.

Radiographs taken for Scientific and Medical Men, and Demonstrations given.

HARVEY & PEAK

(BY APPOINTMENT TO THE ROYAL INSTITUTION OF GREAT BRITAIN)

HAVE FOR DISPOSAL A NUMBER OF

NICOL PRISMS AND TOURMALINES of various Sizes.

PROJECTION POLARISCOPEs of various Sizes in Stock, with large Nicol Prisms:—

STUDENTS' SPECTROMETERS.—P. O. Bridge Sets, for Schools.—Induction Coils.—Wimshurst Machines.—

X-Ray Apparatus.—Optical Banks, &c., &c.

H. & P. are the actual Manufacturers of the above.

56 CHARING CROSS ROAD, LONDON, W.C.

L. CASELLA,

Scientific Instrument Maker,
Engineer, &c.



THEODOLITES.
LEVELS.
SEXTANTS.
HORIZONS.
COMPASSES.
TELEMETERS.
TIDE GAUGES.
STEAM AND PRESSURE
GAUGES.
ANEROIDS.
&c., &c.

PARTICULARS AND PRICES MAY BE
HAD ON APPLICATION.

WRITE FOR DESCRIPTIVE PAMPHLETS AND CATALOGUES
OF SURVEYING INSTRUMENTS, &c.

147 Holborn Bars,
LONDON, E.C.

Telegraphic Address:—"ESCUTCHEON, LONDON."
Telephone:—No. 1034, HOLBORN.

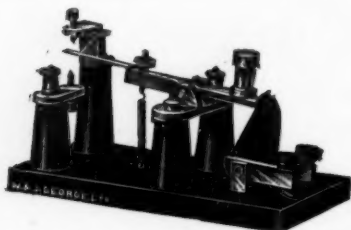
"NIVOC" SPECIALITIES.

WORKS—BIRMINGHAM.

Buy direct

*from the
Manufacturers.*

THESE INSTRUMENTS ARE SPECIALLY
SUITED FOR WORKING TOGETHER.



KEMPE'S CHARGING & DISCHARGING KEY,
Improved Form with rubbing contacts, highly
insulated, £3 15s. Highest quality and finish.



"NIVOC" MOVING COIL GALVANOMETER
BALLISTIC, very sensitive. To work with $\frac{1}{2}$ Micro-
Farad Condenser, £2 10s.



STANDARD CONDENSER, $\frac{1}{2}$ Micro-
Farad, £2 12s. 6d.

STANDARD CLARK CELL, 25s. net.

W. & J. GEORGE, LTD., 33-37 HATTON WALL, LONDON.
(Late F. E. BECKER & CO.)

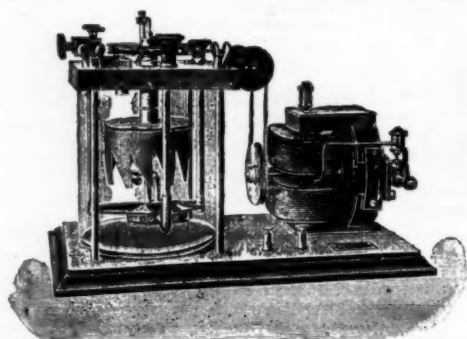
ISENTHAL, POTZLER & CO.,

85 MORTIMER STREET, LONDON, W.

Telegrams: "HYSTERESIS."

Telephone: 2099, GERRARD.

CENTRAL DEPOT for RADIOGRAPHERS.



MERCURY JET INTERRUPTER.

3000-50,000 Interruptions per Second.

Write for Lists, or better inspect our
Installations.

HIGHEST REFERENCES.

EVERYTHING NOVEL & ORIGINAL.

Sole Agents for Scotland:

Messrs. JAMES WHITE, Cambridge Street, Glasgow.

DUDELL OSCILLOGRAPH

An Invaluable Instrument for
Alternate Current Work.

This Galvanometer has the shortest
periodic time of any Instrument
yet constructed, viz. 0.0001 Second,
is perfectly dead-beat and the self-
induction is practically nil.

Write for Descriptive Pamphlet.

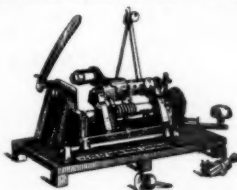
SOLE MAKERS—

SCIENTIFIC INSTRUMENT CO.
LIMITED,
CAMBRIDGE.

W. G. PYE & CO.,
"GRANTA" WORKS, MILL LANE, CAMBRIDGE.

MAKERS OF PHYSICAL, PHYSIOLOGICAL, AND OTHER SCIENTIFIC INSTRUMENTS.

Sole Makers of Leake's Patent
Flat-cutting Rocking Microtome.
Unsurpassed for ordinary work,
unequalled for Botanical work.
Price, as illustrated, in Case,
£6 6 0



LEAKE'S PATENT MICROTOME.

CAMBRIDGE PATTERN Rocking
Microtome, in Case, £3 5s.
Resistance Boxes from £3.
Improved Reflecting Galvanometers,
£3.
School Galvanometers from 10s. 6d.

PYE'S Improved Pattern Boyle's Law Apparatus ... £1 5 0 } As shown at the recent Educational Exhibition at South
" " Constant Volume Air Thermometer 0 15 0 } Kensington with the Cambridge University Exhibits.
" PRICE LISTS AND PAMPHLETS ON APPLICATION. (ILLUSTRATED CATALOGUE IN PREPARATION.)

NEW SCIENCE LANTERN.

SOLE MAKERS:
REYNOLDS & BRANSON,
Ltd.

IMPROVED
PORTABLE
DESIGN.



The Universal Science Lantern has been devised for the projection of experiments. In the short box in front of the lantern is a hinged mirror, so placed that by the movement of a stud it may be introduced and placed at an angle of 45 degrees with the parallel beam. The beam is thus sent upwards through a horizontal convergent lens, on which a slide or horizontal piece of apparatus can be placed. Above this is the objective mounted on a brass pillar, and above the objective a prism or mirror (if the screen is elevated above the lantern plain prisms are required for each beam), silvered on the outside so that there is no double reflection. The mirror can be adjusted to any angle, and is intended to send the image in an approximately horizontal direction to the screen. Slides can also be directly projected in the usual way.

The base-board is made to fold so that the lantern can be packed into a box 18½ x 8½ x 20½ with all its accessories *in situ*.

Price Complete, in Travelling Box, £9 0 0
REYNOLDS & BRANSON, LTD.
14 COMMERCIAL STREET, LEEDS.

OBSERVATIONS AND - - - SCIENTIFIC INVESTIGATIONS

Can be performed easily
and quickly, and impor-
tant facts and deductions
neatly and legibly re-
corded, with the aid of a
Writing Machine. The
one that will enable the
Scientist to obtain the
best results, and give
him the greatest satisfac-
tion, is undoubtedly that
Marvel of Mechanical
Skill,



THE
YŌST
TYPE-
WRITER.

For full particulars of this wonderful Instrument, send
for Illustrated "E" Catalogue to

The YŌST TYPEWRITER Co., Ltd.,
50 HOLBORN VIADUCT,
London, E.C.

WEST END DEPÔT:—303 Oxford Street.

Now Ready, 8vo, Price 6s. net.

RECENT & COMING ECLIPSES.

BY

SIR NORMAN LOCKYER, K.C.B., F.R.S.

Second Edition, containing an account of the observations made at Vizianagur, in India, in 1898, and of the conditions of the Eclipses visible in 1900, 1901 and 1905.

MACMILLAN AND CO., LTD., LONDON.

LIVING SPECIMENS FOR THE MICROSCOPE.

Volvox, Spirogyra, Desmids, Diatoms, Amœba, Arcella, Actinosphaerium, Vorticella, Stentor, Hydra, Floscularia, Stephanoceros, Melicerta, and many other Specimens of Pond Life. Price 12. per Tube, Post Free. Helix pomatia, Astacus, Amphioxus, Rana, Anodon, &c., for Dissection purposes.

THOMAS BOLTON,

25 BALSALL HEATH ROAD, BIRMINGHAM.

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM.

THE LABORATORY, PLYMOUTH.

The following animals can always be supplied, either living or preserved by the best methods:—

Sycon; Clava, Obelia, Sertularia; Actinia, Tealia, Caryophyllia, Alcyonium; Hormiphora (preserved); Leptoplana; Lineus, Amphiporus; Nereis, Aphrodite, Arenicola, Lanicæ, Terebella; Lepas, Balanus, Gammarus, Ligia, Mysis, Nebalia, Carcinus; Patella, Buccinum, Eledone, Pectens, Bugula, Crisia, Pedicellina, Holothuria, Asterias, Echinus; Ascidia, Salpa (preserved), Scyllium, Raja, &c., &c.

For prices and more detailed lists apply to Biological Laboratory, Plymouth.

THE DIRECTOR.

THE MOST NUTRITIOUS.

E P P S'S

GRATEFUL—COMFORTING.

C O C O A

BREAKFAST—SUPPER.

THE IRISH NATURALIST.

A Monthly Magazine of Irish Zoology, Botany, and Geology. Price 6d.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD PRAEGER, B.A.

Annual Subscription, 5s. Post Free to any Address.

Dublin: EASON & SON, LTD., 40 Lower Sackville Street (to which Address Subscriptions should be sent).

London: SIMPKIN, MARSHALL, HAMILTON, KENT, & CO., Ltd.

NOTICE.—Advertisements and business letters for NATURE should be addressed to the Publishers; Editorial communications to the Editor. The telegraphic address of NATURE is "PHUSIS," LONDON.

SUBSCRIPTIONS TO "NATURE."

	£	s.	d.
Yearly	1	8	0
Half-yearly	0	14	6
Quarterly	0	7	6
TO ALL PLACES ABROAD:—			
Yearly	1	10	6
Half-yearly	0	15	6
Quarterly	0	8	0

Cheques and Money Orders payable to MACMILLAN & CO., Limited.

OFFICE: ST MARTIN'S STREET, LONDON, W.C.

CO-OPERATIVE WORLD TRAVEL

Organised by HENRY S. LUNN, M.D., F.R.G.S.,
W. HOLDSWORTH LUNN & CONNOP F.S. PEROWNE.

A Cruise to the CENTRAL MEDITERRANEAN.

(MARSEILLES, PALMA, ALGIERS, MALTA, SICILY, CAPRI, NAPLES, MARSEILLES.)

(Return Ticket to MARSEILLES included.)

AN EIGHTEEN DAYS' CRUISE FOR £21 OS. AND UPWARDS.

s.v. ARGONAUT. Tonnage, 3254; h.p., 4000.

£10 10s. and £13 13s. TOURS TO ROME.

Extensions to NAPLES, FLORENCE, VENICE,
and the ITALIAN LAKES.

Full particulars from the Secretary, 5 Endsleigh Gardens,
Euston, London, N.W.

MINERALS, ROCKS, AND PRECIOUS STONES.

Choice Minerals for Museums, Characteristic Examples for the Teacher, Student, or Prospector.

LAPIDARIES' WORK IN ALL BRANCHES.

BLOWPIPE CASES AND APPARATUS.

LESSONS GIVEN.

SAMUEL HENSON,

97 REGENT STREET, LONDON, W.

ESTABLISHED 1840.

PHYSIOGRAPHY and GEOLOGY.

COLLECTIONS & MICROSCOPIC SLIDES,

As advised by Science and Art Directory, arranged by

JAMES R. GREGORY & CO.,
Mineralogists, &c.

To Science and Art Department, British, Indian and Colonial
Museums, &c.

NOVELTIES and RARE GEMS and PRECIOUS
STONES.

Mineral Specimens for Museums, and Collectors, and all purposes
Rock Specimens and Microscopic Sections of Rocks and Minerals
cut to order.

NEW AND VALUABLE MINERAL SPECIMENS CONSTANTLY
ARRIVING.

Stores & Offices: 1 Kelso Place, KENSINGTON, W.

NEW CATALOGUES AND LISTS FREE.

HOLLOWAY'S OINTMENT CURES

Gout, Rheumatism, Lumbago, Sciatica, Cuts
Bruises, Sprains, &c.

INVALUABLE FOR ALL SKIN DISEASES.

Holloway's Ointment and Pills may be obtained of
all Medicine Vendors.

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
*Three Lines in Column	0	2	6
Per Line after	0	0	9
One Eighth Page, or Quarter Column	0	18	6
Quarter Page, or Half a Column	1	15	0
Half a Page, or a Column	3	5	0
Whole Page	6	6	0

* The first line being in heavy type is charged for as Two Lines.

MAGMILLAN & CO.'S SCIENCE CLASS BOOKS.

ADAPTED TO THE SOUTH KENSINGTON SYLLABUSES.

I.—PRACTICAL PLANE & SOLID GEOMETRY.

Practical Plane and Solid Geometry. By J. HARRISON, M.Inst.M.E., &c. Instructor in Mechanics and Mathematics, and G. A. BAXANDALL, Assistant Instructor Royal College of Science, London. Part I. ELEMENTARY. 2s. 6d. Part II. ADVANCED. 4s. 6d.

Test Papers in Practical Plane and Solid Geometry. Elementary Stage. By GEORGE GRACE, B.Sc. (Lond.). 24 Tests printed on Cartridge Paper. 2s.

III.—BUILDING CONSTRUCTION.

Building Construction for Beginners. By J. W. RILEY, Rochdale Technical School. 2s. 6d.

V.—MATHEMATICS.

An Elementary Course of Mathematics. Comprising Arithmetic, Algebra, and Euclid. By H. S. HALL, M.A., and F. H. STEVENS, M.A., Masters of the Military Side, Clifton College. 2s. 6d.

Graduated Test Papers in Elementary Mathematics. By WALTER J. WOOD, B.A. 1s.

Practical Mathematics. By F. CASTLE, M.I.M.E. 3s. 6d.

VI.—THEORETICAL MECHANICS.

Mechanics for Beginners. By W. GALLATLY, B.A. 2s. 6d.

Mechanics for Beginners. By Rev. J. B. LOCK, M.A. Part I. Mechanics and Solids. 2s. 6d.

Hydrostatics for Beginners. By F. W. SANDERSON, M.A. 2s. 6d.

VII.—APPLIED MECHANICS.

Lessons in Applied Mechanics. By Prof. J. H. COTTERILL, F.R.S., and J. H. SLADE. 5s. 6d.

VIII.—SOUND, LIGHT, AND HEAT.

Elementary Lessons in Heat, Light, and Sound. By D. E. JONES, B.Sc., Inspector of Science Schools under the Science and Art Department. 2s. 6d.

Heat for Advanced Students. By E. EDSER, A.R.C.Sc. 4s. 6d.

Exercises in Practical Physics for Schools of Science. By Prof. R. A. GREGORY and A. T. SIMMONS, B.Sc. (Lond.). In two parts. 2s. each.

Elementary Physics. By BALFOUR STEWART, F.R.S. New Edition, thoroughly Revised. 4s. 6d. Questions. 2s.

IX.—MAGNETISM AND ELECTRICITY.

Electricity and Magnetism for Beginners. By F. W. SANDERSON, M.A. 2s. 6d.

Magnetism and Electricity for Beginners. By H. E. HADLEY, B.Sc. (Lond.). 2s. 6d.

Elementary Lessons in Electricity and Magnetism. By Prof. SILVANUS P. THOMPSON, F.R.S. New Edition. 4s. 6d.

X. & XI.—CHEMISTRY.

INORGANIC CHEMISTRY—THEORETICAL.

Chemistry for Beginners. By Sir HENRY ROSCOE, F.R.S., assisted by J. LUNT, B.Sc. New Edition, revised. 2s. 6d.

The Elements of Chemistry. By Prof. IRA REMSEN. 2s. 6d.

Inorganic Chemistry for Advanced Students. By Sir H. E. ROSCOE, F.R.S., and Dr. A. HARDEN. 4s. 6d.

X. & XI.—CHEMISTRY—continued.

Chemical Problems. By Prof. T. E. THORPE, F.R.S. With Key. 2s.

Chemical Arithmetic. By S. LUPTON, M.A. With 1200 Problems. 4s. 6d.

Inorganic Chemistry. By Prof. IRA REMSEN. 6s. 6d.

INORGANIC CHEMISTRY—PRACTICAL.

Chemistry for Organised Schools of Science. By S. PARRISH, B.Sc., A.R.C.S. (Lond.), with Introduction by Dr. FORSYTH. 2s. 6d.

Practical Inorganic Chemistry. By G. S. TURPIN, M.A., D.Sc. 2s. 6d.

Practical Inorganic Chemistry for Advanced Students. By CHAPMAN JONES, F.I.C., F.C.S. 2s. 6d.

The Junior Course of Practical Chemistry. By F. JONES, F.C.S. 2s. 6d. The New Edition of this book covers the Syllabus of the South Kensington Examination.

ORGANIC CHEMISTRY—THEORETICAL.

Organic Chemistry for Beginners. By G. S. TURPIN, M.A., D.Sc. 2s. 6d.

Organic Chemistry. By Prof. IRA REMSEN. 6s. 6d.

XII.—GEOLOGY.

Geology for Beginners. By W. W. WATTS, M.A., F.G.S. 2s. 6d.

XIV.—HUMAN PHYSIOLOGY.

Physiology for Beginners. By Sir MICHAEL FOSTER, K.C.B., and Dr. L. E. SHORE. 2s. 6d.

Physiology for Advanced Students. By A. STANLEY KENT, M.A. (Oxon.). [In preparation.]

Lessons in Elementary Physiology. By the Right Hon. T. H. HUXLEY, F.R.S. 4s. 6d. Questions. 1s. 6d.

XVII.—BOTANY.

Botany for Beginners. By ERNEST EVANS, Burnley Technical School. 2s. 6d.

XIX.—METALLURGY.

A Text-Book of Elementary Metallurgy. By A. H. HIORNS, Principal of the School of Metallurgy, Birmingham and Midland Institute. 3s. Questions. 1s.

XXIII.—PHYSIOGRAPHY.

Experimental Science (Section I. Physiography). By Prof. R. A. GREGORY and A. T. SIMMONS, B.Sc. 2s. 6d.

Physiography for Beginners. By A. T. SIMMONS, B.Sc. 2s. 6d.

Physiography for Advanced Students. By A. T. SIMMONS, B.Sc. 4s. 6d.

Elementary Lessons in Astronomy. By Sir NORMAN LOCKVER, K.C.B. New Edition. 5s. 6d. This book contains all the Astronomy required for the Advanced and Honours Stages.

XXIV.—THE PRINCIPLES OF AGRICULTURE.

Agriculture for Beginners. By A. J. COOPER, Harris Institute, Preston. [In preparation.]

Elementary Lessons in the Science of Agricultural Practice. By H. TANNER, F.C.S. 3s. 6d.

XXV.—HYGIENE.

Hygiene for Beginners. By E. S. REYNOLDS, M.D. 2s. 6d.

Handbook of Public Health and Demography. By E. F. WILLOUGHBY, M.B. New and Revised Edition. 4s. 6d.

MAGMILLAN AND CO., LIMITED, LONDON.

MACMILLAN & CO.'S NEW SCIENTIFIC BOOKS.

ENLARGED AND REVISED EDITION NOW READY.

LESSONS IN ELEMENTARY PHYSIOLOGY.

BY THOMAS H. HUXLEY, LL.D., F.R.S.

Enlarged and Revised Edition. Globe 8vo. 4s. 8d.

AN ELEMENTARY COURSE OF PRACTICAL ZOOLOGY.

By the late **T. JEFFERY PARKER**, D.Sc., F.R.S., Professor of Biology in the University of Otago, Dunedin, New Zealand, and **W. NEWTON PARKER**, Ph.D., Professor of Zoology at the University College of South Wales and Monmouthshire, in the University of Wales. With 156 Illustrations. Crown 8vo. 10s. 6d.

A MANUAL OF ZOOLOGY.

By the late Prof. **T. J. PARKER**, D.Sc., F.R.S., and Prof. **W. A. HASWELL**, M.A., D.Sc., F.R.S.

With Three Hundred Illustrations. Crown 8vo, 10s. 6d.

KNOWLEDGE.—"The text is accompanied by about three hundred beautiful illustrations. . . . The treatment is explicit throughout, and the book is sure to gain a wide popularity."

FIELD.—"For those who require a manual to assist them in acquiring an accurate knowledge of zoology we know of no book superior to that under notice. . . . The illustrations are admirable. We know of no work better fitted to fulfil the purpose for which it was designed than the one under notice. It is an admirable introductory text-book to scientific zoology."

TEXT-BOOK OF PALÆONTOLOGY.

By **KARL A. VON ZITTEL**,

Professor of Geology and Palæontology in the University of Munich. Translated and Edited by **CHAS. R. EASTMAN**, Ph.D., Assistant in Palæontology in the Museum of Comparative Zoology at Harvard. With 1476 Woodcuts. Medium 8vo. 25s. net.

. This English Edition is revised and enlarged by the Author and Editor in collaboration with numerous Specialists.

SPEAKER.—"In this sphere Prof. Zittel's books have long held the field as the standard works of their class, but to many they have been inaccessible on account of their being in a foreign tongue. . . . It has not merely been translated; it has been edited and brought up to date as well. . . . The author and editor have conferred a great boon upon their fellow-workers, whether English or foreign, by bringing out what is really a new edition of this work. . . . A most valuable addition to the scientific literature of the world, and the publication of the second volume, dealing with the Vertebrata, will be awaited with the keenest interest on all sides."

VOL. III. (COMPLETING THE WORK) NOW READY.

DICTIONARY OF POLITICAL ECONOMY. Edited by R. H. INGLIS PALGRAVE.

Vol. III. (completing the work). Medium 8vo, 21s. net. Also ready, Vols. I. and II., 21s. net each.

STATIST.—"Brings to completion an excellent cyclopædia of all matters pertaining to political economy."

DEMOCRACY AND EMPIRE, WITH STUDIES OF THEIR PSYCHO-

LOGICAL, ECONOMIC, AND MORAL FOUNDATIONS. By **FRANKLIN HENRY GIDDINGS**, M.A., Ph.D., Professor in Columbia University, New York. 8vo. 8s. 6d. net.

MONOPOLISTS AND TRUSTS. By RICHARD T. ELY, Ph.D., LL.D., Professor of Political Economy and Director of the School of Economics, Political Science, and History in the University of Wisconsin. Crown 8vo. 5s. net.

THE PRINCIPLES OF MECHANICS PRESENTED IN A NEW FORM.

By **HEINRICH HERTZ**, late Professor of Physics in the University of Bonn. With an Introduction by **H. von HELMHOLTZ**. Authorised English Translation by **D. E. JONES**, B.Sc., District Inspector under the Department of Science and Art, &c., and **J. T. WALLEY**, M.A. 8vo. 10s. net.

ENGINEER.—"A very remarkable book. . . . A book which it is impossible to pass over in silence, fraught as it is with infinite possibilities of the future. It represents the latest work of one of the finest intellects of the century."

INTRODUCTION TO PHYSICAL CHEMISTRY. By JAMES WALKER, D.Sc.,

Ph.D., Professor of Chemistry in University College, Dundee. 8vo. 10s. net.

LANCET.—"The book is written in such a lucid way as to render its perusal free from that irksomeness which is so often the student's experience when confronted with theoretical considerations. The book should serve as an admirable introduction to more advanced works."

THE THEORY OF ELECTROLYTIC DISSOCIATION AND SOME OF

ITS APPLICATIONS. By **HARRY C. JONES**, Associate in Physical Chemistry in Johns Hopkins University. Extra crown 8vo. 7s. net.

THE TEACHING OF ELEMENTARY MATHEMATICS. By DAVID EUGENE

SMITH, Principal of the State Normal School at Brockport, New York. Crown 8vo. 4s. 6d. net.

[Teachers' Professional Library.]

THE NATURE AND WORK OF PLANTS. An Introduction to the Study of

Botany. By **DANIEL TREMBLY MACDOUGAL**, Ph.D., Director of the Laboratories, New York Botanical Garden. Crown 8vo. 4s. 6d.

MACMILLAN AND CO., LIMITED, LONDON.

NOTICE.—SPECIAL RE-ISSUE BY NATURE
OF THE
INTERNATIONAL SCIENTIFIC SERIES
FOR A STRICTLY LIMITED PERIOD.

EIGHTY-SIX VOLUMES.

**A COMPLETE LIBRARY OF SCIENCE AT
A GREATLY REDUCED PRICE.**

PUBLISHERS' PRICE	...	...	...	...	£21 10 0
BY INSTALMENT (TO-DAY)	...	...	...	...	£14 14 0
FOR CASH	...	...	...	...	£13 10 0

The "International Scientific Series" has a world-wide reputation, and is to be found in every well-equipped Library throughout the English-speaking world. No more generous or acceptable present could be made to any Public Library or individual than this magnificent Encyclopædia of Scientific Research.

Most of the works are illustrated, and many with beautiful coloured plates. The Series has been contributed to by men of science of the highest eminence, such as Tyndall, Herbert Spencer, Walter Bagehot, Alexander Bain, Stanley Jevons, Huxley, Sir John Lubbock, G. J. Romanes, Balfour Stewart, Sir Norman Lockyer, Draper, Bonney, Sir Hubert Parry, Sir E. Maunde Thompson. This list only professes to convey a slight idea of the attention that has been given to the whole Series by the selection of only the best writers to deal with the various subjects considered.

This special offer is open only for a short time, and intending purchasers will do well therefore to send their orders without delay.

For the benefit of those who do not feel disposed to buy the entire Series, it will be possible to secure half the Series, making 43 volumes, for £7 cash, or £7 7s. on the instalment system, the purchaser himself selecting the volumes. The whole Series or half, as the case may be, will be sent on receipt of the first payment of One Guinea—the rest to be paid at the rate of £1 1s. per month.

NOTE:—This OFFER will be WITHDRAWN almost immediately.

ORDER AT ONCE.

A Set of the Volumes may be seen at the Office of NATURE, ST. MARTIN'S STREET, W.C.

A Pamphlet, giving titles, &c., of the Works in the Series, Specimen Pages, with Illustrations, of some of the Volumes, also Order Form, will be sent Post Free on application to

C. WORSFOLD, "NATURE" Office, St. Martin's Street, London, W.C.

ORDER FORM.

Date.....1900.

All cheques should be crossed and made payable to C. WORSFOLD, "NATURE" Office, St. Martin's Street, W.C.

I enclose One Guinea as first payment for "NATURE'S Re-issue of the International Scientific Series," and I agree to pay to you, or your representative, the balance at the rate of One Guinea per month; my next payment to be on delivery of the volumes, and my remaining payments on the corresponding day of each month following.

Until such payments are complete, I engage that the Works, not being my property, shall not be disposed of by sale or otherwise.

I further agree that if it be found impossible for any reason to deliver the books, the return of the sum of One Guinea to me shall cancel this agreement.

Name.....

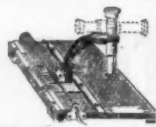
Address.....

Residents abroad are kindly requested to remit in full, or to instruct their representatives in England to make the monthly payments, in order to avoid the expense and delay in forwarding cash from abroad.



ORIGINAL PATTERN ATWOOD
HARRIS'S MACHINE,
7032A, Accurate and Reliable, 8 to 9 feet
high, Graduated, £3 15s.

HARRIS'S SPECIALITIES.—CATALOGUES UPON APPLICATION.



Vernier Microscope,
796A, £2 2s. 6d.



Registered Differ-
ential Thermo-
meter, 6287A,
15s. 6d.



New Cathetero-
meter, 787C,
£5 1s. 6d.



Drawing
Model

Complete Laboratory Furnishing.

ESTIMATES FREE.

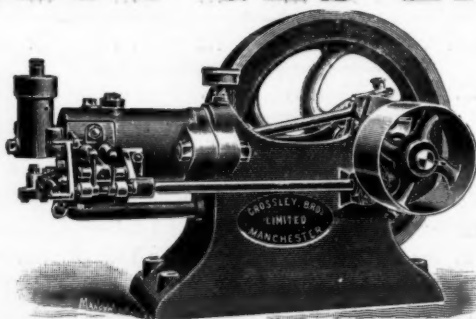
Telegraphic Address :
"Science," Birmingham.
Telephone No. 10.

PHILIP HARRIS & Co., LTD.,

COMPLETE LABORATORY FURNISHERS, BIRMINGHAM.

CROSSLEY'S GAS ENGINES.

RECENTLY
REMODELLED.



GREAT
REDUCTION
IN
GAS
CONSUMED.

CROSSLEY BROS., LTD., OPENSHAW, MANCHESTER.

WATSON'S NEW MICROSCOPES AND APPARATUS.



WATSON'S HOLOSCOPIC EYEPIECES, for use with either APOCHROMATIC or ACHROMATIC OBJECTIVES, an adjustment being provided to the special lenses employed, for altering the correction. There is no sacrifice of efficiency, the performance being equal to the most expensive Compensating or Huyghenian Oculars.

Magnifying Powers—

6 in. tube length, 5, 7, 10, and 14 diameters.
10 in. " 7, 10, 14, and 20 "

PRICE, in Student's Size and Pattern, either power, 17/6 each.

For Full Particulars see Supplemental List, Post Free.

WATSON'S PARACHROMATIC OIL IMMERSION CONDENSER.

Total aperture, 1'30; aplanatic aperture exceeds 1'25. Undoubtedly the finest Condenser obtainable for high-power work. Optical part only ... £5 0 0

Completely mounted with Iris Diaphragm and Set of Stops ... £6 10 0

WATSON'S "SCHOOL" MICROSCOPE, New Model, complete with 1 in. Objective, in Case ... £3 3 0

WATSON'S "ROYAL" MICROSCOPE. A new model high-class instrument.

WATSON'S "FRAM" MICROSCOPE. A highest-class instrument at a very moderate cost.

BACTERIOLOGICAL APPARATUS. MICROTOMES. Apparatus for FIELD BOTANY and FIELD GEOLOGY. METAMORPHOSES and DISSECTED PREPARATIONS. BOTANICAL and PHYSIOLOGICAL MODELS.

For Particulars of all the above, see Watson's New Supplemental List to Catalogue No. 2, Post Free on application.

Watson's Catalogue (No. 3) is a Classified List representing a Stock of 40,000 first-class Micro-Slides, Post free on application.

W. WATSON & SONS (Established 1837), Opticians to H.M. Government.

313 HIGH HOLBORN, LONDON, W.C. New Branch Now Open: 16 FORREST ROAD, EDINBURGH. And at 78 Swanston Street, Melbourne, Australia. Awarded 39 Gold and other Medals at the principal International Exhibitions of the World.



DALLMEYER'S POPULAR HAND CAMERA.

PRICE
£7 7s.

Twelve 1-plates in sheaths, instantaneous changing, rack focussing, ever-set shutter with speed regulator, mahogany body covered good leather, and fitted with a **STIGMATIC LENS**, working at f. 7'5.

Send for fully Illustrated List of Lenses and Cameras.

J. H. DALLMEYER, Ltd., 25 Newman St., LONDON, W.

Printed by RICHARD CLAY AND SONS, LIMITED, at 7 & 8 Broad Street Hill, Queen Victoria Street, in the City of London and published by MACMILLAN AND CO., LIMITED, at St. Martin's Street, London, W.C., and THE MACMILLAN COMPANY, 66 Fifth Avenue, New York.—THURSDAY, March 22, 1900.

GENERAL LIBRARY,
UNIV. OF MICH.
APR 11 1900



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

No. 1587, VOL. 61]

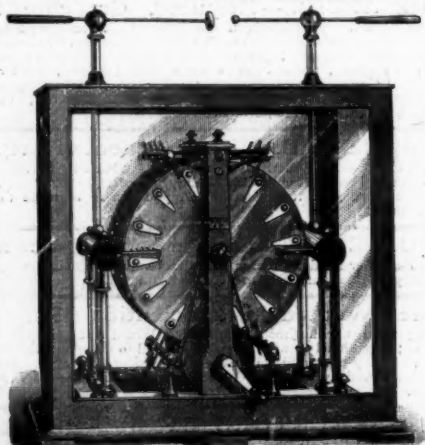
THURSDAY, MARCH 29, 1900.

[PRICE SIXPENCE.]

Registered as a Newspaper at the General Post Office.]

[All Rights are Reserved.]

WIMSHURST INFLUENCE ELECTRICAL MACHINES.



Multiple-Plate Machine, with 8 plates, 18 inches, £22.
For X-Ray and Therapeutic work.

NEWTON & CO., Makers, 3 FLEET ST., LONDON.

SHORT BEAM BALANCES.

CHEAP, QUICK-ACTING,
ACCURATE,
KNIFE EDGES AND PLANES OF AGATE
Compensating Stirrup
Suspensors.

To carry 200, 300 grammes.

Price £7. £9 9s.

ASSAY BALANCES.

ALUMINIUM BEAMS.
5 Grammes in each Pan.
Indicate $\frac{1}{10}$ m.g.

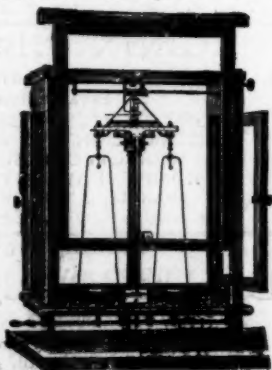
£10 10s. and £7.

CHEMICAL BALANCE.

ALUMINIUM BEAM.
New design Sliding Rider.
To carry 100 250 grms.

Indicates $\frac{1}{10}$ m.g. $\frac{1}{10}$ m.g.
£8 15s. £10 10s.

WRITE for BALANCE CATALOGUE



JOHN J. GRIFFIN & SONS, ^{LD}
20-26 SARDINIA STREET, LONDON, W.C.

THE FIVE WINDOWS OF THE SOUL. A POPULAR ACCOUNT OF THE HUMAN SENSES. BY EDWARD HAMILTON AITKEN.

Crown 8vo. 6s.

"There is probably nothing in recent literature which will so surely lead to a thirst for further and more technical knowledge than the author's treatment of these difficult subjects. . . . It is admirably written, and cannot fail to give pleasure. It is so seldom that such a really good book as this is published that the hope may be expressed that it will meet with the success it deserves, and find a place in every good public and private library."—*Manchester Guardian*.

COLOUR IN NATURE.

A STUDY IN BIOLOGY.
BY MARION NEWBIGIN.

Crown 8vo 7s. 6d.

"All who seek for well sifted results, and not merely superficial information, will thank her for this book, and congratulate her on a very timely contribution to biological literature."—*Journal of Education*.

JOHN MURRAY, ALBEMARLE STREET, W.

NEGRETTE & ZAMBRA'S



IMPROVED
SELF-RECORDING RAIN-
GAUGES, BAROMETERS &
THERMOMETERS.

Giving continuous Records
on Charts which only require
changing weekly.

Invaluable to Invalids and
others unable to take daily
readings.

Illustrated Price List of Instruments free by Post to all
parts of the World.

NEGRETTE & ZAMBRA,
38 HOLBORN VIADUCT, E.C.

BRANCHES: 45 CORNHILL, and 122 REGENT STREET.

THE LONDON HOSPITAL MEDICAL COLLEGE.

The SUMMER SESSION commences on May 1.

The Hospital is the largest in the kingdom; nearly 800 beds are in constant use, and no beds are closed. Being the only General Hospital for East London—i.e. for a million and a half people—the practice is immense. In-patients last year, 11,622; Out-patients, 178,838; Accidents, 17,370; Major Operations, 2320.

APPOINTMENTS.—Owing to the enormous number of patients, more Appointments are open to Students than at any other Hospital. Sixty qualified Appointments are made annually, and more than 150 Dressers, Clinical Clerks, &c., appointed every three months. All are free to Students of the College. Holders of Resident Appointments have Free Board.

SCHOLARSHIPS AND PRIZES.—Twenty-seven Scholarships and Prizes are given annually. Students entering in May can compete for five Entrance Scholarships in September.

Special arrangements have been made to enable Students entering in May to present themselves for examination in Chemistry, &c., in July.

SPECIAL CLASSES are held for the University of London and other higher Examinations. Special entries for Medical and Surgical Practice can be made. Qualified Practitioners will find excellent opportunities for studying the rarest diseases.

A reduction of 15 Guineas is made to the Sons of Members of the Profession. ENLARGEMENT OF THE COLLEGE.—The new Laboratories and Class-rooms for Bacteriology, Public Health, Operative Surgery, Chemistry, Biology, &c., have now been added, with all modern improvements.

The Club's Union Athletic Ground is within easy reach of the Hospital. The Metropolitan and other Railways have Stations close to the Hospital and College.

For Prospectus and information as to Residence, &c., apply personally, or by letter, to

MUNRO SCOTT, Warden.

Mile End, E.

GLASGOW ROYAL INFIRMARY.

The SUMMER SESSION opens on APRIL 24, 1900. The number of beds, including the Ophthalmic Department, is 670.

Special Wards and Beds are set apart for the treatment of the Diseases of Women, of the Throat and Nose and of the Ear; and there is a specially well-equipped department for the treatment of Diseases and Injury of the Eye. Women Students are admitted to the Clinical Teaching and Practice of the Infirmary; Medical and Surgical Wards being set apart for their exclusive use.

HOUSE APPOINTMENTS.—Five House Physicians and Seven House Surgeons are elected every six months, and an Assistant to the Gynecologist, who boards but is non-resident, is elected at the same time. Women are eligible for this appointment.

Dressers, Clinical Clerks, and Assistants to the Pathologist are selected from the Students.

BURSARIES.—The David Foulis Scholarship and the John Reid Prize, value £25 each, are open to Students of the Royal Infirmary.

Fees, which include Hospital Practice and the Clinical Lectures—for one year, £10 10s; six months, £6 6s; Three Months, £4 4s. The total fee is £31. Vaccination, £1 1s. Pathology, £4 4s. Bacteriology, £3 2s. For further information apply to

M. THOMAS, M.D., Superintendent.

THE LONDON SCHOOL OF TROPICAL MEDICINE

(UNDER THE AUSPICES OF HER MAJESTY'S GOVERNMENT),
CONNAUGHT ROAD, ALBERT DOCK, E.

IN CONNECTION WITH THE HOSPITALS OF THE SEAMEN'S HOSPITAL SOCIETY.

The next SESSION commences on TUESDAY, MAY 1, 1900.

For Prospectus, Syllabus, and other particulars, apply to the Secretary, P. MICHELLI, Esq., Seamen's Hospital, Greenwich, S.E.; or to Dr. Rees, the Medical Tutor, at the School.

UNIVERSITY COLLEGE, LONDON.

FACULTY OF MEDICINE.

The Summer Session begins on May 1st. The work is arranged so that a Student may advantageously begin his Medical Curriculum then. Full information may be obtained from either of the undersigned.

H. R. SPENCER, M.D., F.R.C.P.,

Dean of the Faculty.

J. M. HORSBURGH, M.A., Secretary.

THE COLLEGE HALL OF RESIDENCE FOR WOMEN STUDENTS.

WYNG PLACE, LONDON, W.C.

The Office of Principal will become vacant at the end of the present Session, and the Council are prepared to receive applications from intending Candidates for the Appointment up to the 15th of May.

For particulars, apply by letter to the HON. SECRETARY at College Hall.

SCIENCE EXAMINATIONS.

For LONDON and other UNIVERSITIES, the
CONJOINT BOARD, &c.

Well-equipped LABORATORIES, DAY AND EVENING. Personal or Class Tuition.

"R," 9 Heathcote Street, Gray's Inn Road, W.C.

BREWOD GRAMMAR SCHOOL.

HEAD MASTER required, to commence duties in Michaelmas next. He must be a Graduate of some University in the United Kingdom, and Graduates in Arts or Science are invited to apply.

The School, besides the general side, contains an Agricultural side and Farm School, towards which an annual grant is made by the Staffordshire County Council.

Stipend, £200 a year, with capitation fee of £2 per boy. Good residence and boarding house; newly erected Science Laboratory and Class Room.

Applications, together with not more than three testimonials, and the names of three references, to be sent in by April 30th, under cover, to the Clerk, Mr. EDWD. BEETLESTONE, Brewod, near Stafford, from whom further details may be obtained.

By Order.

EDWD. BEETLESTONE,

Clerk to the Governors.

Brewod, Stafford, March 24, 1900.

SCIENCE AND ART EXAMS.

LONDON AND SOUTH KENSINGTON.

Oral or Correspondence Preparation by SPECIALIST TUTORS.

New and Perfected System of Correspondence Tuition. WORKSHEETS
A SPECIALITY, saving Time and Trouble.

ADDRESS:—

JOHN GIBSON, M.A., 24 CHANCERY LANE
W.C.

SCHOLASTIC.—Required, Graduate for

Chemistry and Physics (Practical and Theoretical), Secondary School; salary £150, non-resident. Also for County School, Master for Chemistry, Physics and Geography; qualified to earn Grants from South Kensington; fair salary, non-res. Also for Technical School, Master for Practical Chemistry and Drawing; salary £80, res. Many other Vacancies.—Address, GRIFFITHS, SMITH, POWELL & SMITH, Tutorial Agents, 34 Bedford Street, Strand.

DUMFRIES ACADEMY (School of Art).—

WANTED, an ART MASTER, holding "Art Master's Certificate," to commence duty in September. Salary according to experience, but not exceeding £180 to begin with. Application to be made to the RECTOR.

REQUIRED, Cambridge Nat. Science

Tripes man, or London B.Sc. in Honours, to give tuition in Botany and Zoology.—State terms, &c., to "X," NATURE Office.

Partner Wanted in a Scientific Manufac-

turing Business, with £1000 or upwards. Would suit Scientific Man or Son; exceptional opening; Capital wanted to carry out the Orders open, and—by enlarging Business—to avail of greatly increased trade waiting. Profits very large.—Address, "Scientific," care of NATURE Office.

FLAT SKELETONS OF SMALL ANI-

MALS AND BIRDS, made and mounted in Glass-topped Boxes, by Miss T. SMITH; Sladen Mount, Arnside, Westmoreland. Prices on application.

INDEXING BY B.A. (CAMB.) 8d. PER

Hour, or "by Piece." Testimonials. "S. V. J.," 298 Uxbridge Road, W.

PHENIX FIRE OFFICE,

9 LOMBARD ST., E.C., and 57 CHARING CROSS, S.W.

ESTABLISHED 1782.

MODERATE RATES. ABSOLUTE SECURITY.

ELECTRIC LIGHTING RULES SUPPLIED.

LIBERAL LOSS SETTLEMENTS.

PROMPT PAYMENT OF CLAIMS.

FRANCIS B. MACDONALD, SECRETARY.

LOSSES PAID OVER £22,000,000.

ESTABLISHED 1861.

BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

INVESTED FUNDS

£10,000,000.

The BIRKBECK ALMANACK, with full particulars, post free.

FRANCIS RAVENSCROFT, Manager.

BARGAINS IN SCIENTIFIC BOOKS.

BEDDARD, M.A. (FRANK E.), ANIMAL COLORATION. An Account of the Principal Facts and Theories relating to the Colours and Markings of Animals. With 4 Coloured Plates and Woodcuts in the Text, Demy 8vo, Cloth (6s.). 2s. 9d.

BATESON (W.), MATERIAL FOR THE STUDY OF VARIATION, treated with especial regard to Discontinuity in the Origin of Species. By WILLIAM BATESON, M.A., Fellow of St. John's College, Cambridge. 8vo, Cloth (pub. 21s. net). 5s.

"The whole work must be carefully read by every serious student; and there can be no question of its great and permanent value as a contribution to our knowledge of a particular class of variations, and as a stimulus to further work in a department of knowledge which is too much neglected."—*Nature*.

COLE, F.R.M.S. (A. C.), THE METHODS OF MICROSCOPICAL RESEARCH. A PRACTICAL GUIDE TO MICROSCOPICAL MANIPULATION. Second Edition, much enlarged, 8vo, Cloth (6s.). 1s. 6d.

GORE, F.R.A.S., M.R.I.A., &c. (J. E.), THE WORLDS OF SPACE. A Series of Popular Articles on Astronomical Subjects. Illustrations, Crown 8vo, Cloth (pub. 7s. 6d.). 1s. 6d.

SANDFORD (E.), A MANUAL OF EXOTIC FERNS AND SELAGINELLA. Comprising descriptions of over 1000 Species and Varieties, and upwards of 600 Synonyms, also Notes on their History, Culture and Management. Crown 8vo, Cloth (6s. 6d.). 1s. 3d.

BRITTEN, F.L.S. (JAMES), EUROPEAN FERNS, THEIR FORM, HABIT AND CULTURE, with 30 Facsimile Coloured Plates, Painted from Nature, by D. BLAIR, F.L.S., Demy 4to, Cloth (21s.). 7s.

NEWMAN, F.Z.S. (EDWARD), BRITISH BUTTERFLIES AND MOTHS. Illustrated with nearly 900 Life-size Figures of Species of Butterflies and Moths. Super Royal 8vo, Cloth, Gilt Edges (25s.). 12s.

Postage 4d. extra on one, or 6d. on two.

H. J. GLAISHER, New and Remainder Bookseller,
57 WIGMORE STREET, LONDON, W.

See Catalogues Post Free on application.

WATKINS & DONCASTER,

NATURALISTS,

AND MANUFACTURERS OF

CABINETS AND APPARATUS

FOR ENTOMOLOGY, BIRDS' EGGS, AND ALL BRANCHES OF NATURAL HISTORY.

SPECIAL SHOW-ROOM FOR CABINETS.

Call or send for detailed Catalogue (66 pp.), Post free on application.

N.B.—For Excellence and Superiority of Cabinets and Apparatus, references are permitted to distinguished patrons, Museums, Colleges, &c.

A LARGE STOCK OF INSECTS AND BIRDS' EGGS.

Birds, Mammals, &c., Preserved and Mounted by First-class Workmen with true natural surroundings. All Books and Publications on Natural History supplied.

36 STRAND, LONDON, W.C.

(Five Doors from Charing Cross.)

PHYSIOGRAPHY and GEOLOGY.

COLLECTIONS & MICROSCOPIC SLIDES,

As advised by Science and Art Directory, arranged by

JAMES R. GREGORY & CO.,

Mineralogists, &c.

To Science and Art Department, British, Indian and Colonial Museums, &c.

NOVELTIES and RARE GEMS and PRECIOUS STONES.

Mineral Specimens for Museums, and Collectors, and all purposes, Rock Specimens and Microscopic Sections of Rocks and Minerals cut to order.

NEW AND VALUABLE MINERAL SPECIMENS CONSTANTLY ARRIVING.

Stores & Offices: 1 Kelso Place, KENSINGTON, W.

NEW CATALOGUES AND LISTS FREE.

THE SCIENTIFIC ROLL AND MAGAZINE OF SYSTEMATIZED NOTES.

THIS WORK IS A VALUABLE
GUIDE, BIBLIOGRAPHY, AND INDEX TO SCIENCE.

In preparation.

BACTERIA (Botanical Section).

Although these are the simplest of plants, there is probably no group of organisms which exceeds them in interest or importance. Their operations affect the *wellfare of every member of the community*, as also of the whole organic world. A full knowledge of them is essential in all questions bearing upon public and private health, agriculture, the microbial diseases of animals and of plants; and it is important in many industries, such as those dealing with milk, butter, hay, flax, tobacco, and others.

The group will be dealt with in three octavo volumes of about 500 pp. each. The subscription price will be 10s. for each volume, payable on delivery of the first number of the volume; or arrangements may be made to supply only the portions relating to a particular species, genus, or topic, at a proportionately reduced rate. The first volume will be commenced next summer, and if sufficient subscribers support the work, the three volumes will be completed in three years. As all the matter will be systematized, the series will be equivalent to a good bacteriological library, with the advantage that the information on any particular point will be comprised within a comparatively few pages, and not scattered over thousands of pages in a host of journals and books.

The names and addresses of subscribers, and applications for prospectus may be sent to the undersigned.

The undersigned will be glad to hear from PRINTERS willing to give estimates for printing, and from PUBLISHERS willing to consider terms for publishing the above-mentioned work.

A. RAMSAY,
4 Cowper Road, Acton, London, W.

Now Ready. 8vo. Price 4s. net.

INORGANIC EVOLUTION

AS STUDIED BY

SPECTRUM ANALYSIS.

BY

SIR NORMAN LOCKYER, K.C.B., F.R.S.

MACMILLAN AND CO., LTD., LONDON.

MINERALS, ROCKS & FOSSILS.

COLLECTIONS FOR STUDENTS.

Carefully labelled and arranged in Boxes with Card Trays.

50 Minerals, 12/6; 100 do., 21/-; 200 do., 42/-.

Rocks and Fossils at similar prices.

300 Minerals in Cabinet, £4 4s.; 400 do., £5 12s. 6d.

Catalogues Post Free.

THOMAS D. RUSSELL,

78 NEWGATE STREET, LONDON, E.C.

TO SCIENCE LECTURERS. HUGHES' MOTO-PHOTOSCOPE FOR LIVING PICTURES.

THE MOST PERFECT.

No SHUTTER, therefore no Flickering. Superb Mechanism.

The Moto-Photo Camera for taking the Pictures. Illustrated Lists, 2d. See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN, &c. Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great success. New Oxyhydrogen Microscope. Science Lanterns for Class Demonstration. Magnificent Results. Docwra Triple, Prize Medals. Highest Award. Supplied to the Royal Polytechnic Institution, Dr. H. GRATTAN GUINNESS, Madame ADELINA PATTI, &c., &c. Patent Pamphengo, Science Lanterns. The Universal Lantern 4-inch Condensers, 4-wick Lamp, Portrait Combination front Lenses, 18s. 6d., Marvellous value. Science Lecture Sets. Novelties. The Lantern Kaleidoscope. Cheapest Lantern Outfits in the World. Grandly Illustrated Catalogue, over 180 choice Engravings, 6d.; Postage, 3d. List of 300 Lecture Sets, Science Subjects, Views, &c., 6d.; Postage 2d. Pamphlets Free. W. C. HUGHES, SPECIALIST, Brewster House, 8s Mortimer Road, Kingsland, N.

**A NEW STEREOSCOPIC BINOCULAR
FIELD GLASS**
Of NEW FORM and CONSTRUCTION.



(English Patents, Nos. 5639 and 7942, 1894.)

Of handy size, with large field, brilliant definition, perfect achromatism, and very decided STEREOSCOPIC effect, and which, when once adjusted, are always ready for use.

Prices: £6 to £8.

For NAVAL MEN and DEERSTALKERS, &c. (we have made larger sizes for NIGHT and DAY USE, admitting more light, but f somewhat greater weight). Prices: Night, £10; Day, £11.

Illustrated Price List free.

CARL ZEISS (of JENA),

29 MARGARET STREET, REGENT STREET, LONDON, W.

JAS. SWIFT & SON,

MANUFACTURING OPTICIANS.



SOLELY APPOINTED TO THE A.M. DEPT.
WAR OFFICE, FOR THE SUPPLY
OF MICROSCOPES.

Patent form of Student's Microscope, fitted with $\frac{2}{3}$ " and $\frac{1}{6}$ " Pan-Aplanatic Objectives, Iris Diaphragm and Oculars, in Case, from

£5 5s.

These Instruments we have supplied in numbers to the following Medical Schools, viz. St. Mary's, St. Bartholomew's, Guy's, Middlesex, London, and St. Thomas's.

Seven Gold Medals awarded for excellence of manufacture.

Catalogue on Application.

81 TOTTENHAM COURT ROAD, W.



C. BAKER,
MICROSCOPE
MANUFACTURER,
1889—1900.

CATALOGUE Post Free to readers
of this Journal. Apply—
244 HIGH HOLBORN, W.C.

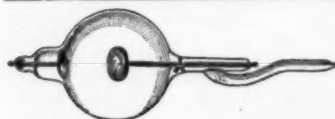
EVERETT & CO.,
MECHANICAL ENGINEERS & ELECTRICIANS,
22 CHARTERHOUSE SQUARE, E.C.
MAKERS OF HIGH-GRADE
PHYSICAL & ELECTRICAL APPARATUS.

Apparatus designed and made for Laboratories and Research Work.

ALL KINDS OF EXPERIMENTAL WORK.

Our List is now ready, and may be had post free on application.

See "Notes" in NATURE, March 15, 1900.



COSSOR,

87
FARRINGTON RD.,
E.C.

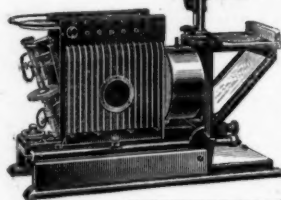
Original Maker of "X" RAY TUBES in England.

FOCUS TUBES giving finest possible definition. IMPROVED TUBE HOLDERS, with arrangement for securing wires to avoid perforation of tube. All kinds of "X" Ray Apparatus, Mercury Pumps, Screens, Spark Gaps, &c. Applications for Price Lists invited.

Medals and Highest Awards at all Great Exhibitions.

ROSS'

ESTD. 1830.



NEW SERIES
SCIENCE LANTERNS
FOR SCHOOLS,
COLLEGES, & PRIVATE
EXHIBITIONS.

PHOTOGRAPHIC LENSES
AND CAMERAS.
MICROSCOPES,
TELESCOPES, FIELD
GLASSES, &c. &c.

**ROSS' PATENT
NEW MODEL**

PRISMATIC
BINOCULAR GLASS.



"The power and field of a Telescope in the compass of an Opera Glass."

Combining Extreme Portability with High Power, Perfect Mechanical Construction, and Exquisite Definition.

Magnification.	Binocular.
6 times ...	£8 0 0
8 " ...	8 0 0
10 " ...	10 0 0
12 " ...	10 0 0

ROSS, Ltd., Manufacturing Opticians,

111 NEW BOND STREET, LONDON, W.,
And 31 COCKSPUR STREET, CHARING CROSS, S.W.

**IMPROVED D'ARSONVAL
GALVANOMETERS.**

PRICES
£10-0-0

AND

£4-10-0

LIBERAL DISCOUNTS.

Most
SENSITIVE
for
DEFLECTIVE,
ZERO,
OR
BALLISTIC
WORK.



Write for Price List and Particulars of Potentiometers, Galvanometers, Electrical Thermometers, Experimental Direct and Alternating Current Sets, &c., to

CROMPTON & CO., Ltd.,
Laboratory { "THRIPLANDS," } LONDON, W.
KENSINGTON COURT,

DUDELL OSCILLOGRAPH

**An Invaluable Instrument for
Alternate Current Work.**

This Galvanometer has the shortest
periodic time of any Instrument
yet constructed, viz. 0.0001 Second,
is perfectly dead-beat and the self-
induction is practically nil.

Write for Descriptive Pamphlet.

SOLE MAKERS—

**SCIENTIFIC INSTRUMENT CO.
LIMITED,
CAMBRIDGE.**

For Photography, Unsurpassed for fine definition.

COOKE LENSES

TAYLOR, TAYLOR, & HOBSON,
Stoughton Street Works, Leicester;
and 18 Berners Street, London, W.

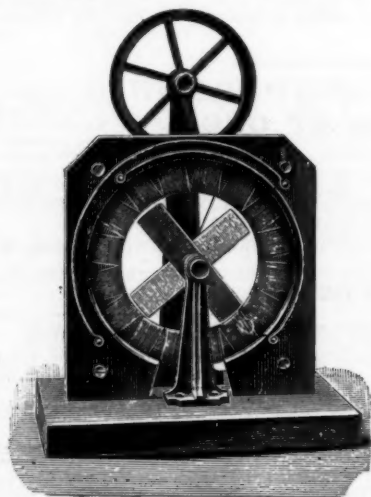
LETCHER & SONS (formerly Letcher Bros.),

SCIENTIFIC INSTRUMENT MAKERS,
25 TURNPIKE LANE, HORNSEY, N.

BLOWPIPE CABINETS. SPECIALITY: SOCIETY OF ARTS SETS.
PRICE LIST, POST FREE, ON APPLICATION.

E. LEYBOLD'S NACHFOLGER,

SCIENTIFIC INSTRUMENT
MAKERS,
COLOGNE (GERMANY).



New Catalogue of Physical Apparatus,
containing 3400 numbers and 1200 illustrations,
sent on application.

W. WILSON,

Makers of

SPECTROSCOPES, SPECTROMETERS,
GONIOMETERS,
OPTICAL BENCHES, OPTICAL AND OTHER
MEASURING INSTRUMENTS.
BEST WORK. MODERATE PRICES.

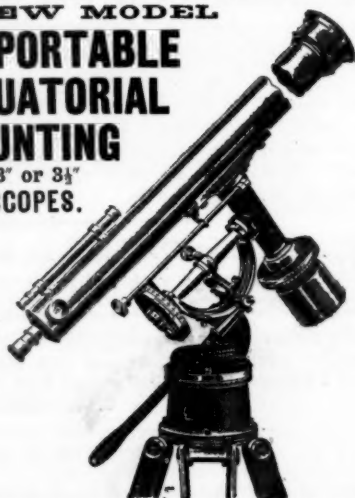
Price List Free.

1, BELMONT STREET, CHALK FARM, N.W.

NEW MODEL

PORTABLE EQUATORIAL MOUNTING

For 3" or 3½"
TELESCOPES.



Latitude Adjustment, Clamp for Declination Axis, Quick and Slow Motion, in Right Ascension.

EQUATORIAL MOUNTING with Divided Circles and Stand
fitted with short Iron Column, Levelling Screws, and Metal
Stretchers, £15 15s.; or, complete with 3" Telescope, £25.

ILLUSTRATED CATALOGUE GRATIS.

J. H. STEWARD,
OPTICIAN,

406 STRAND, 457 WEST STRAND,
7 GRACECHURCH STREET, LONDON.

FINAL NOTICE RESPECTING THE SPECIAL RE-ISSUE BY NATURE OF THE INTERNATIONAL SCIENTIFIC SERIES.

EIGHTY-SIX VOLUMES.

**A COMPLETE LIBRARY OF SCIENCE AT
A GREATLY REDUCED PRICE.**

PUBLISHERS' PRICE	...	...	...	...	£21 10 0
BY INSTALMENT (TO-DAY)	...	...	...	...	£14 14 0
FOR CASH	...	...	...	...	£13 10 0

The "International Scientific Series" has a world-wide reputation, and is to be found in every well-equipped Library throughout the English-speaking world. No more generous or acceptable present could be made to any Public Library or individual than this magnificent Encyclopædia of Scientific Research.

Most of the works are illustrated, and many with beautiful coloured plates. The Series has been contributed to by men of science of the highest eminence, such as Tyndall, Herbert Spencer, Walter Bagehot, Alexander Bain, Stanley Jevons, Huxley, Sir John Lubbock, G. J. Romanes, Balfour Stewart, Sir Norman Lockyer, Draper, Bonney, Sir Hubert Parry, Sir E. Maunde Thompson. This list only professes to convey a slight idea of the attention that has been given to the whole Series by the selection of only the best writers to deal with the various subjects considered.

For the benefit of those who do not feel disposed to buy the entire Series, it will be possible to secure half the Series, making 43 volumes, for £7 cash, or £7 7s. on the instalment system, the purchaser himself selecting the volumes. The whole Series or half, as the case may be, will be sent on receipt of the first payment of One Guinea—the rest to be paid at the rate of £1 1s. per month.

NOTE:—As this OFFER is about to be WITHDRAWN, Orders at present prices must be sent AT ONCE.

A Set of the Volumes may be seen at the Office of NATURE, ST. MARTIN'S STREET, W.C.

A Pamphlet, giving titles, &c., of the Works in the Series, Specimen Pages, with Illustrations, of some of the Volumes, also Order Form, will be sent Post Free on application to

C. WORSFOLD, "NATURE" Office, St. Martin's Street, London, W.C.

ORDER FORM.

Date.....1900.

All cheques should be crossed and made payable to C. WORSFOLD, "NATURE" Office, St. Martin's Street, W.C.

I enclose One Guinea as first payment for "NATURE's Re-issue of the International Scientific Series," and I agree to pay to you, or your representative, the balance at the rate of One Guinea per month; my next payment to be on delivery of the volumes, and my remaining payments on the corresponding day of each month following.

Until such payments are complete, I engage that the Works, not being my property, shall not be disposed of by sale or otherwise.

I further agree that if it be found impossible for any reason to deliver the books, the return of the sum of One Guinea to me shall cancel this agreement.

Name.....

Address.....

Residents abroad are kindly requested to remit in full, or to instruct their representatives in England to make the monthly payments, in order to avoid the expense and delay in forwarding cash from abroad.

LIVING SPECIMENS FOR THE MICROSCOPE.

Volvox, *Spirogyra*, *Desmids*, *Diatoms*, *Amoeba*, *Arcella*, *Actinosphaerium*, *Vorticella*, *Stentor*, *Hydra*, *Floscularia*, *Stephanoceros*, *Melicerata*, and many other Specimens of Pond Life. Price 1s. per Tube, Post Free. *Helix omatis*, *Astacus*, *Amphioxus*, *Rana*, *Anodon*, &c., for Dissection purposes.

THOMAS BOLTON,

25 BALSALL HEATH ROAD, BIRMINGHAM.

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM.

THE LABORATORY, PLYMOUTH.

The following animals can always be supplied, either living or preserved by the best methods:—

Sycon; *Clava*, *Obelia*, *Sertularia*; *Actinia*, *Tealia*, *Caryophyllia*, *Alcyonium*; *Hormiphora* (preserved); *Leptoplana*; *Lineus*, *Amphiporus*; *Nereis*, *Aphrodite*, *Arenicola*, *Lanice*, *Terebella*; *Lepas*, *Balanus*, *Gammarus*, *Ligia*, *Mysis*, *Nebalia*, *Carcinus*; *Patella*, *Buccinum*, *Eledone*, *Pecten*, *Bugula*, *Crisis*, *Pedicellina*, *Holothuria*, *Asterias*, *Echinus*; *Ascidia*, *Salpa* (preserved), *Scyllium*, *Rais*, &c., &c.

For prices and more detailed lists apply to Biological Laboratory, Plymouth.

THE DIRECTOR.

HOLLOWAY'S PILLS CURE

Biliousness, Sick Headache, Indigestion, and all Internal Complaints.

CAN BE TAKEN BY THE MOST DELICATE.

Holloway's Pills and Ointment may be obtained of all Medicine Vendors.

CO-OPERATIVE WORLD TRAVEL

Organised by HENRY S. LUNN, M.D., F.R.G.S., W. HOLDSWORTH LUNN & CONNOP F.S. PEROWNE.

A Cruise to the CENTRAL MEDITERRANEAN.

(MARSEILLES, PALMA, ALGIERS, MALTA, SICILY, CAPRI NAPLES, MARSEILLES.)

(Return Ticket to MARSEILLES included.)

AN EIGHTEEN DAYS' CRUISE FOR £21 OS. AND UPWARDS.

S.V. ARGONAUT. Tonnage, 3254; h.-p., 4000.

£10 10s. and £13 13s. TOURS TO ROME.

Extensions to NAPLES, FLORENCE, VENICE, and the ITALIAN LAKES.

Full particulars from the Secretary, 5 Endsleigh Gardens, Euston, London, N.W.

THE MOST NUTRITIOUS.

E P P S'S

GRATEFUL—COMFORTING.

C O C O A

BREAKFAST—SUPPER.

ALBERT EDWARD JAMRACH

(Late CHARLES JAMRACH),

NATURALIST,

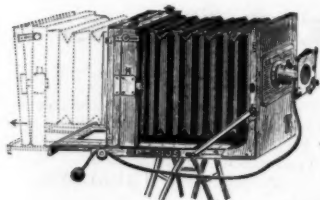
180 ST. GEORGE STREET EAST.

Implements of Savage Warfare, Idols, Sacred Masks, Peruvian Pottery Netsukia China. Lacquers. Gongs. Shells, and other Curios.

TRADE MARK

"OPTIMUS."

TELEGRAPHIC ADDRESS.



PHOTOGRAPHIC APPARATUS

OF BEST WORKMANSHIP
FOR ALL PURPOSES.

Catalogue POST FREE.



PERKEN, SON & CO., LTD., 99, HATTON GARDEN, LONDON.
HOLBORN CIRCUS, E.C.

APRIL NUMBER NOW READY.

THE SCHOOL WORLD.

A MONTHLY MAGAZINE OF EDUCATIONAL WORK AND PROGRESS. PRICE SIXPENCE.

Annual Subscription, including postage, 8s. net.

CONTENTS.

The Board of Education—Its Work and Relations with the Chief Grades of Secondary Schools: INSPECTION AND REGISTRATION. By Rev. T. W. Sharpe, C.B., M.A.; THE GREAT PUBLIC SCHOOLS. By Rev. H. W. Moss, M.A.; GRAMMAR AND PROPRIETARY SCHOOLS. By Dr. R. P. Scott, M.A.; TECHNICAL INSTRUCTION COMMITTEES. By William Hewitt, B.Sc.; PRIVATE SCHOOLS. By Rev. J. O. Bevan, M.A., F.S.A.; HIGHER GRADE SCHOOLS. By William Dyche, B.A.—**The Study of "As You Like It."** I.: General Conception of the Play. By J. A. Nicklin, B.A.—**On the Use of the Voice in Teaching.** By Patrick Kirwan.—Experimental Chemistry. (Illustrated.) III.: Composition of Water; Hydrogen; Natural Waters; Distillation; Solution. By Prof. J. B. Coleman, A.R.C.S., F.I.C.—**Pioneers in Education.** IV.: Rousseau as an Unpractical and as a Practical Educationist. By Prof. Foster Watson, M.A.—Teachers' Notes on English History, 1603–1715. V.: The Sons of Charles I., 1660–1688. By C. S. Fearenside, M.A., and L. J. McNair, B.A.—**Manual Instruction in Secondary Schools.** By W. A. Knight.—The Board of Education Act, 1899.—Commercial Education in France.—The School Pulpit. War and Righteousness. By Rev. H. W. Moss, M.A.—Items of Interest. General; Welsh; Scottish; Irish; From Abroad; Current History.—**Dr. Leaf's "Iliad."** (Illustrated.)—Reviews of Recent School Books.—London Matriculation, June, 1900. Monthly Test Papers, No. 4.—Junior Oxford Local Examination, July, 1900. Monthly Test Papers, No. 4.—Preliminary Oxford Local Examination, July, 1900. Monthly Test Papers, No. 4.—Correspondence: **Use of the Lantern in Teaching.** By Prof. W. C. F. Anderson, M.A. Alternative Course in English Grammar. By J. C. Nesfield, M.A., and Your Reviewer.—Our Chess Column.—Calendar.

MACMILLAN AND CO., LIMITED, LONDON.

The 'N. & G.' Cameras

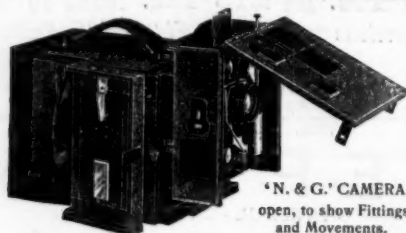
In all sizes up to 7 x 5 in.
For Plates, Cut Films, or Film
in Spools.

For Hand and Tripod.

A Series of High-Class Instruments for Serious Work,
embodying every New Advance in Photography.

Prices from £13 to £50.

Have been in Constant Use for Eight Years in all parts of the World.



'N. & G.' CAMERA,
open, to show Fittings
and Movements.

TRIPOD CAMERAS, SURVEYING CAMERAS, and very Small and
Light POCKET CAMERAS for Travellers and Field Naturalists.

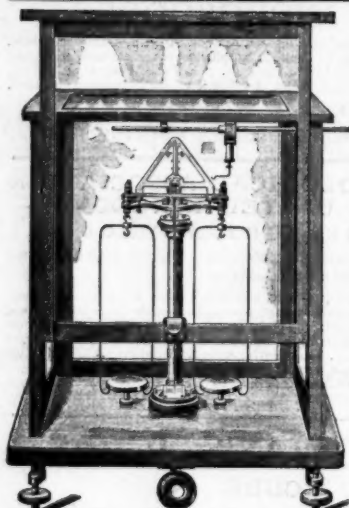
Speciality: COMPLETE OUTFITS for Scientific Expedi-
tions and Special Research.

Catalogues and Estimates † Lenses, Kinematographs, Lanterns, and all
free on application. ‡ Photographic Accessories and Materials.

Newman & Guardia, Ltd.

90 & 92 Shaftesbury Avenue, London, W.

SHORT BEAM CHEMICAL BALANCE.



Short Beam
Chemical Balance
for a charge up to
100 grammes in each
Pan, sensible to
1/10th part of a
milligramme. In
Mahogany Glass
Case, with
Solid Marble Base,
Counterpoised
Sliding Front and
Side Doors, Alu-
minium Beam,
divided from the
centre in 1/10th of a
milligramme.
Rider Apparatus.
All Knife Edges
are of Agate
working on Agate
Planes. Automatic
Arrestment for
arrest of Pans and
Beam.
Pans 7 cm. diameter.
Level and
Levelling Screws.

£7 7 0

List of BALANCES
Post Free.

Illustrated Lists of Chemical and Physical Apparatus also
on application.

C. E. MÜLLER & CO.,
SCIENTIFIC GLASS BLOWERS
AND MANUFACTURERS OF
CHEMICAL AND PHYSICAL APPARATUS.
148 High Holborn, London, W.C.

OPPOSITE THE BRITISH MUSEUM.

THACKERAY HOTEL

(TEMPERANCE).

GREAT RUSSELL STREET, LONDON.

THIS newly-erected and commodious Hotel will, it is believed, meet the requirements of those who desire all the conveniences and advantages of the larger modern licensed hotels at moderate charges. Passenger Lift. Electric Light in all Rooms. Bath-rooms on every Floor. Spacious Dining, Drawing, Writing, Reading, and Smoking Rooms. All Floors Fireproof. Perfect Sanitation. Night Porter. Telephone. Bedrooms from 2s. 6d. to 4s. 6d. per night. Full Tariff and Testimonials on application.

Telegraphic Address: "THACKERAY, LONDON."

Proprietor—J. TRUSLOVE.

Also, amalgamated with, and under the same management,

ESMOND HOTEL

(TEMPERANCE).

MONTAGUE STREET, RUSSELL SQUARE.

THIS Hotel, which has been carried on so successfully for the last 13 years, adjoins the British Museum, and is exception-
ally quiet. Bedrooms from 2s. to 3s. 6d. per night. Full Tariff and Testimonials on application.

Telegraphic Address: "TRUSLOVE, LONDON."

Proprietor—J. TRUSLOVE.

TO SCIENTIFIC MEN, NATURALISTS, TRAVELLERS, AND OTHERS.

THE STEREOSCOPIC COMPANY

CAN SPECIALLY
RECOMMEND ANY OF
THE FOLLOWING
HAND CAMERAS.



Address—
106 & 108 REGENT ST., W.,
and 4 Cheapside, E.C.

THE TWIN-LENS ARTIST,

with full size Focussing
Finder, Rapid Euryscope
Lenses, Time and Instanta-
neous Shutter, Raising Front,
Focussing Adjustment,
Double Dark Slides,
Magazine or Cartridge
Roll Holders.

1/4-p. complete, with £ s.
3 Slides ... 14 14

5 x 4 complete,
with 3 Slides 16 16

1/4-p. complete, with
3 Slides ... 21 0

THE TWIN-LENS ARTIST,

with
MAGAZINE

for 12 Plates or
24 Films,
&c., &c.,
as described.



1/4-p. complete... £ s.
5 x 4 " ... 15 15

1/4-p. " ... 17 17

1/4-p. " ... 22 3

THE TWIN-LENS CARLTON,

Carrying 12 Plates
or Films,
and now so well known
as not to
need description.

PRICE:

1/4-p. complete ... £ s.
5 x 4 " ... 12 12

1/4-p. " ... 15 15

1/4-p. " ... 21 0

PLEASE READ

Extract of Letter from
R. BOWDLER SHARPE,
Esq., LL.D.,
Assist. Keeper Zoological
Dept., British Museum,
March 4, 1898:—

"I consider it one of the
best day's work I ever did
when I bought one of your
Cameras. The ease with
which it is worked, and the
excellent results obtained,
make it a most pleasurable
accompaniment of a summer's
outing."

FREE LESSONS TO
PURCHASERS.



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 1588, Vol. 61]

THURSDAY, APRIL 5, 1900.

[PRICE SIXPENCE.

Registered as a Newspaper at the General Post Office.]

[All Rights are Reserved.

SCOUTING AND OUTPOST TELESCOPE,

AS SUPPLIED TO THE WAR DEPARTMENT FOR
THE OFFICERS AT THE FRONT.



Magnifying 25 diameters, 42/-.

Also in **ALUMINIUM**, very light. Larger sizes up to
£5 : 15 : 6, magnifying 35 diameters.

FIELD GLASSES IN CASE,
40/-, 45/-, 90/-, 100/-.

NEWTON & CO.,
3 FLEET STREET, LONDON.
CATALOGUE, POST FREE.

BECK'S

NEW

MICROSCOPE

THE

"BRITISH STUDENTS."

Microscope Stand No. 55, as
figured, with Iris Diaphragm,
One Eye-piece; Double Nose-
piece, Two Object-glasses, 2/3"
and 1/6", adjusted to be in
about focus, and the whole
packed in polished Mahogany
Case,

£6 : 8 : 6

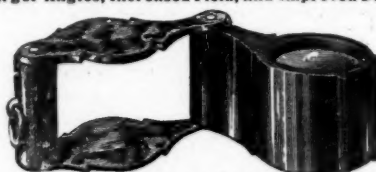


No. 55.

R. & J. BECK, Ltd.,
68 CORNHILL, LONDON, E.C.

BROWNING'S PLATYSCOPIC LENS.

With Larger Angles, Increased Field, and Improved Definition.



Engraved Real Size.

AN ACHROMATIC COMBINATION,
COMBINING THE DEFINITION OF A MICROSCOPE WITH THE
PORTABILITY OF A POCKET LENS.

"If you carry a small Platyscopic Pocket Lens (which every observer of
Nature ought to do)."—GRANT ALLEN in *Knowledge*.

The Platyscopic Lens is invaluable to botanists, mineralogists, or ento-
mologists, as it focuses about three times as far from the object as the
Coddington Lenses. This allows opaque objects to be examined easily.

The Platyscopic Lens is made of four degrees of power, magnifying
respectively 10, 15, 20, and 30 diams.; the lowest power, having the largest
field, is the best adapted for general use.

The Lenses are set in Ebonite Cells, and mounted in Tortoiseshell Frames.
Price of the Platyscopic Lens, mounted in Tortoiseshell, magnifying either
10, 15, 20, or 30 diameters, each power, 15s.

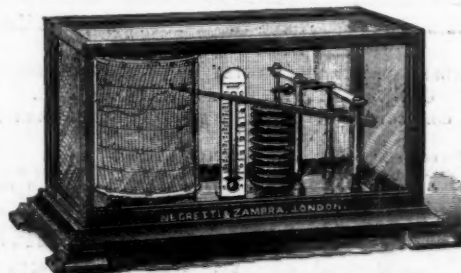
In nickel-plated German Silver, each power, 17s. 6d.

Illustrated Description sent free.

JOHN BROWNING, 63 STRAND, LONDON, W.C.

NEGRETTI & ZAMBRA'S Self-Registering Barometers, Thermometers and Rain Gauges.

Giving continuous Records on Charts, and only requiring attention
once a week.



THE LARGE SIZE BAROGRAPH, £7 10 0

Accurate Thermometers for all purposes.

Illustrated Price List of Instruments free by post to all
parts of the World.

38 HOLBORN VIADUCT, E.C.

BRANCHES—45 CORNHILL, and 122 REGENT STREET.

GUY'S HOSPITAL MEDICAL SCHOOL.

The SUMMER SESSION will begin on May 1, and Students then entering will be eligible to compete for Entrance Scholarships of the combined value of £410 in the following September, as well as for the numerous Medals, Scholarships, and Prizes awarded during the period of Studentship.

The Hospital contains accommodation for 644 beds, and arrangements are being made as rapidly as possible to place the entire number at the service of the sick poor, by reopening the Wards that have been closed for want of funds for the last fifteen years.

The Appointments tenable by Students have recently been increased by more than 150 a year, chiefly by the addition of Clerkships and Dresserships in the departments of Ophthalmology, Gynaecology, and Otolaryngology.

To augment the teaching of special subjects, Registrars and Tutors have been appointed in the Ophthalmic and Obstetric Departments.

All Hospital Appointments are open to Students without charge, and the holders of Resident Appointments are provided with board and lodging.

The College accommodates 60 Students, under the supervision of a Resident Warden.

The Dental School provides the full Curriculum required for the L.D.S. England.

The Clubs' Union Athletic Ground is easily accessible.

A Handbook of Information for those about to enter the Medical Profession will be forwarded on application.

For the Prospectus of the School, containing full particulars as to Fees, Course of Study advised, Regulations for Students in the College, &c., apply personally, or by letter to the DEAN, Guy's Hospital, London Bridge, S.E.

GLASGOW ROYAL INFIRMARY.

The SUMMER SESSION opens on APRIL 24, 1900. The number of beds, including the Ophthalmic Department, is 612.

Special Wards and Beds are set apart for the treatment of the Diseases of Women, of the Throat and Nose and of the Ear; and there is a specially well-equipped department for the treatment of Diseases and Injury of the Eye. Women Students are admitted to the Clinical Teaching and Practice of the Infirmary; Medical and Surgical Wards being set apart for their exclusive use.

HOUSE APPOINTMENTS.—Five House Physicians and Seven House Surgeons are elected every six months, and an Assistant to the Gynaecologist, who boards but is non-resident, is elected at the same time. Women are eligible for this appointment.

Dressers, Clinical Clerks, and Assistants to the Pathologist are selected from the Students.

BURSARIES.—The David Foulis Scholarship and the John Reid Prize, value £25 each, are open to Students of the Royal Infirmary.

Fees, which include Hospital Practice and the Clinical Lectures—for one year, £10 10s; six months, £6 6s; Three Months, £4 4s. The total fee is £31. Vaccination, £1 1s. Pathology, £4 4s. Bacteriology, £2 2s.

For further information apply to

M. THOMAS, M.D., Superintendent.

LIVERPOOL SCHOOL OF TROPICAL DISEASES.

IN CONNECTION WITH

UNIVERSITY COLLEGE AND ROYAL SOUTHERN HOSPITAL.

CLINICAL PRACTICE.—At the Royal Southern Hospital daily, in the Tropical Wards and Clinical Laboratories.

LABORATORY WORK.—Daily in the Thompson Yates Laboratories.

LECTURES.—Tropical Medicine thrice weekly.

COURSES.—Summer, Lent and Autumn Terms.

FEE.—Ten Guineas. Special arrangements for Board, and Special Terms for Private work.

RESEARCH.—Special facilities for research, and opportunities afforded of participating in expeditions.

The Course is open to fully qualified Women Doctors.

Next Term begins April 17th.

For prospectus and other particulars apply

A. H. MILNE, M.A., Hon. Sec.,
Chamber of Commerce, Liverpool.

THE LONDON SCHOOL OF TROPICAL MEDICINE

(UNDER THE AUSPICES OF HER MAJESTY'S GOVERNMENT),
CONNAUGHT ROAD, ALBERT DOCK, E.

IN CONNECTION WITH THE HOSPITALS OF THE SEAMEN'S HOSPITAL SOCIETY.

The next SESSION commences on TUESDAY, MAY 1, 1900.
For Prospectus, Syllabus, and other particulars, apply to the Secretary, P. MICHELLI, Esq., Seamen's Hospital, Greenwich, S.E.; or to Dr. Rees, the Medical Tutor, at the School.

**BOTANICAL MATERIAL FOR CLASS WORK,
RESEARCH AND PRIVATE STUDENTS.**

J. BACKHOUSE & SON, LIMITED, YORK,

Having now established their new Scientific Department and Experimental Laboratory, are prepared to send Post free on application their new

50 PAGE CATALOGUE,

comprising Cryptogamic and Phanerogamic Material, fresh or preserved; Museum Specimens; Microscopical Preparations; &c., &c.

BIRKBECK INSTITUTION,

Breams Buildings, Chancery Lane, E.C.

Science Classes with Practical Work.

DAY AND EVENING CLASSES for University of London B.Sc.; Prelim. Scientific, Inter. M.B. Examinations and for Conjoint Board, Dental and Pharmaceutical Examinations.

EVENING CLASSES in all stages for Science and Art Department Examinations.

HIGHLY-EQUIPPED LABORATORIES.

Chemistry, Physics, Biology (Zoology and Botany), Metallurgy, Geology and Mineralogy, Microscopy.

Prospectus free. Calendar 6d. (Post 8d.) on application to Secretary.

ST. THOMAS'S HOSPITAL MEDICAL SCHOOL,

ALBERT EMBANKMENT, S.E.

The SUMMER SESSION will commence on TUESDAY, May 1. Students entering in the Summer are eligible to compete for the Science Scholarships of £150 and £60 awarded in October.

A Scholarship of £50, open to University Students, and other Prizes and Scholarships of the value of £500 are offered for annual competition.

All Appointments are open to Students without extra payment. Special Classes for the Examinations of the University of London are held throughout the year.

Tutorial Classes are held prior to the Second and Final Examinations of the Conjoint Board in January, April, and July.

A Register of approved lodgings and of private families receiving Boarders is kept in Secretary's Office.

Excellent Day Club accommodation is provided in the School Building, and an Athletic Ground at Chiswick.

Prospectuses and all particulars may be obtained from the Medical Secretary, Mr. G. KENDLE.

H. P. HAWKINS, M.A., M.D. Oxon., Dean.

UNIVERSITY COLLEGE, LONDON.

FACULTY OF MEDICINE.

The Summer Session begins on May 1st. The work is arranged so that a Student may advantageously begin his Medical Curriculum then.

Full information may be obtained from either of the undersigned.

H. R. SPENCER, M.D., F.R.C.P.,

Dean of the Faculty.

J. M. HORSBURGH, M.A., Secretary.

**BEDFORD COLLEGE, LONDON
(FOR WOMEN).**

YORK PLACE, BAKER STREET, W.

The Easter Term begins on Thursday, April 26th.

Lectures are given in all branches of General and Higher Education.

Students are prepared for all the University of London Examinations in Arts and Science.

A Single Course of Lectures in any subject may be attended.

There is a Department for Professional Training in Teaching, and an Art School. Students can reside in the College.

Prospectus and all particulars on application to the PRINCIPAL.

**BEDFORD COLLEGE, LONDON
(FOR WOMEN).**

YORK PLACE, BAKER STREET, W.

ENTRANCE SCHOLARSHIPS.

The "Henry Tate Scholarship" in Science, annual value £50.

A Pfeiffer Scholarship in Science, annual value £48.

A Reid Scholarship in Arts, annual value £31 10s.

All tenable for three years.

Will be awarded on the results of the Examination to be held at the College on June 26th and 27th. Candidates must be under 19 years of age on the first day of the examination.

For further information apply to the PRINCIPAL.

BARGAINS IN TRAVEL BOOKS.

ASBOTH.—AN OFFICIAL TOUR THRO'

BOSNIA AND HERZEGOVINA, by JOHN DE ASBOTH, Member of the Hungarian Diet, translated under the Author's supervision, Imperial 8vo, Cloth, with numerous Illustrations (pub. 21s.). 2s.

"A most valuable work. . . Profusely illustrated."—*Athenæum*.

"Rich with history, personal adventure, and archaeological lore—a mine of information."—*Full Mail Gazette*.

BONVALOT (G.), THROUGH THE

HEART OF ASIA, OVER THE PAMIR TO INDIA, by GABRIEL BONVALOT, translated by C. B. PITMAN, with 250 Illustrations by ALBERT PÉPIN, 2 Vols., Royal 8vo, Cloth Gilt (pub. 32s.). 8s.

"The writer is a practised traveller, and the various accidents, dangers, and hardships encountered, are faced by the party with all the old traditional French lightness of heart. . . A steady flow of graphic description, amusing incidents, and characteristic talk with people of all classes; vain, ignorant, tyrannical khans, fever-stricken, apathetic peasants, pious pilgrims, and rude fanatics. . . The numerous illustrations are for the most part clever and artistic, and the pictures of scenery of a region little known, and rarely traversed by an artist of any skill, have a special interest."—*Athenæum*.

BATTYE (A. Trevor), ICEBOUND ON

KOLGUEV, a Chapter in the Exploration of Arctic Europe, with Illustrations by J. T. NETTLESHIP and CHARLES WHYMPER, Large Demy 8vo, Cloth (pub. £1 1s. net). 5s. 6d.

"His book will take and keep an authoritative position. . . A modest and ungarnished picture of pluck and endurance that do honour to the English name. . . Ought to be secure of a welcome from a very large number of readers. . . The story is told in a delightfully simple and spontaneous manner. . . Mr. Trevor-Battye's simple and unaffected narrative enables us to learn a good deal."—*Times*.

Postage 6d. extra on one, or 8d. on two.

H. J. GLAISHER, New and Remainder Bookseller,
57 WIGMORE STREET, LONDON, W.

Catalogues Post Free on application.

THE SCIENTIFIC ROLL AND MAGAZINE OF SYSTEMATIZED NOTES.

THIS WORK IS A VALUABLE
GUIDE, BIBLIOGRAPHY, AND INDEX TO SCIENCE.

In preparation.

BACTERIA (Botanical Section).

Although these are the simplest of plants, there is probably no group of organisms which exceeds them in interest or importance. Their operations affect the welfare of every member of the community, as also of the whole organic world. A full knowledge of them is essential in all questions bearing upon public and private health, agriculture, the microbial diseases of animals and of plants; and it is important in many industries, such as those dealing with milk, butter, hay, flax, tobacco, and others.

The group will be dealt with in three octavo volumes of about 500 pp. each. The subscription price will be 10s. for each volume, payable on delivery of the first number of the volume; or arrangements may be made to supply only the portions relating to a particular species, genus, or topic, at a proportionately reduced rate. The first volume will be commenced next summer, and if sufficient subscribers support the work, the three volumes will be completed in three years. As all the matter will be systematized, the series will be equivalent to a good bacteriological library, with the advantage that the information on any particular point will be comprised within a comparatively few pages, and not scattered over thousands of pages in a host of journals and books.

The names and addresses of subscribers, and applications for prospectus may be sent to the undersigned.

Bacteriologists are asked to communicate with the conductor at the address given below.

A. RAMSAY,
4 Cowper Road, Acton, London, W.

ALBERT EDWARD JAMRACH (Late CHARLES JAMRACH), NATURALIST.

180 ST. GEORGE STREET EAST.

Implements of Savage Warfare, Idols, Sacred Masks, Peruvian Pottery, Netsukis China, Lacquers, Gongs, Shells, and other Curios.

A. AND C. BLACK'S LIST.

A TREATISE ON ZOOLOGY.

By E. RAY LANKESTER, M.A., LL.D., F.R.S., Hon. Fellow of Exeter College, Oxford; Director of the Natural History Departments of the British Museum; Fullerian Professor of Physiology and Comparative Anatomy in the Royal Institution of London. Profusely Illustrated. To be completed in Ten Parts. NOW READY. Part III. THE ECHINODERMA. By F. A. BATHER, M.A., assisted by J. W. GREGORY, D.Sc., and E. S. GOODRICH, M.A. Demy 8vo, in paper covers, price 12s. 6d. net; or, in cloth, price 15s. net.

"It is marked by three characteristics, which indeed may be regarded as now indispensable to any scientific work of value—perfect lucidity in the illustrations, which are numerous, and, of course, specially drawn by, or under the direction of, the author; a careful exposition of the historical development of life-forms; and complete biographies on each branch of the subject."—*Literature*.

NOW READY. Demy 8vo, cloth, price 12s. 6d. net.

SEXUAL DIMORPHISM IN THE ANIMAL KINGDOM. A Theory of the Evolution of Secondary Sexual Characters. By J. T. CUNNING- HAM, M.A. Containing 32 Illustrations.

"Mr. Cunningham has elaborated a theory of evolution in answer to the problem: What are the causes which have produced the three kinds of structural difference in animals? He supports his theory by facts and illustrations drawn mainly from the works of others. A book of distinct scientific importance. The present volume is well printed and profusely illustrated with carefully executed figures."—*The Outlook*.

NOW READY. Crown 8vo, cloth, price 3s. 6d.

INTRODUCTION TO STRUC- TURAL BOTANY. Part II. Flowerless Plants. Third Edition. By D. H. SCOTT, M.A., Ph.D., F.R.S., Honorary Keeper of the Jodrell Laboratory, Royal Gardens, Kew.

"It stands out from the ever-increasing crowd of guides, text-books, and manuals, in virtue not only of originality of design, but also of the fact that the subjects treated have been specially investigated for the purpose of the book, so that we have not the mere compilation of a book-man, but an account based on the results of the author's own observation."—*Natural Science*.

NOW READY. Post 8vo, cloth, price 12s. 6d.

ALGEBRA. An Elementary Text-book for the Higher Classes of Secondary Schools and Colleges. Part II. Second Edition. By Prof. GEORGE CHRYSTAL, M.A., LL.D.

"It is the completest work on algebra that has yet come before us, and in lucidity of exposition it is second to none. The author views his subject from the high ground of the educationist, without reference to the exigencies of established examinations; yet neither the candidates who are training for such nor the teachers who prepare them will act wisely if they neglect his lessons."—*Athenæum*.

NOW READY. Demy 8vo, cloth, price 7s. 6d. net.

THE GRAMMAR OF SCIENCE.

By KARL PEARSON, M.A., F.R.S., Professor of Applied Mathematics and Mechanics in University College, London. Second Edition, thoroughly Revised and much Enlarged. Contains Two entirely New Chapters on Natural Selection and Heredity, embracing a Popular Account of Prof. Pearson's own more recent work in this direction. Containing 33 Illustrations in the Text.

"There is a peculiar opportuneness about the appearance of a new edition of this clear exposition of the scientific method and the claims of science to be regarded as the educational instrument, par excellence, for a training in citizenship. . . We have been again and again impressed in examining 'The Grammar' with the remarkable lucidity of Prof. Pearson's explanations."—*The Grammar of Science*.

A. AND C. BLACK, SOHO SQUARE, LONDON.

The Agent-General for the Cape of Good

Hope has been instructed by the Colonial Government to publish the following notice:—

Applications are invited for the post of Dairy Instructor in the Government School at Elsberg (near Mulder's Vlei), in the Cape Colony.

DUTIES.—To give instruction in all branches of Dairy-work and Poultry Farming, to take charge of the Dairy, Cattle and Pigs and Poultry, and to show a general interest in the conduct of Students.

A knowledge of Bacon-curing is desirable.

Salary, £250 per annum, with Quarters and Rations.

Travelling expenses from present domicile to Elsberg, up to £30, will be allowed.

The applicant should be unmarried.

Applications, with testimonials, to be addressed to Professor R. WALLACE, The University, Edinburgh, not later than the 20th April next.

112 Victoria Street, Westminster,
27th March, 1900.

HEATHCOTE SCIENCE LABORATORIES.

These Laboratories are open for RESEARCH work, at any hours or times most convenient for worker, in CHEMISTRY, PHYSICS and BACTERIOLOGY. Facilities for Commercial investigations are supplied. Furnaces and powerful Electrical Currents can be used.

The Fees are at rate of £3 3s. for one month (five days a week, six hours a day). Apparatus supplied free.

Private Laboratory, £4 14s. 6d. a month, or by arrangement.

The above Fees include use of all ordinary Glass and other Apparatus, and use of Accurate Balances and Standard General Instruments, also Furnaces, &c.

9 Heathcote Street, Mecklenburgh Square, | R. C. T. EVANS,
Gray's Inn Road, W.C. | Director.

B.A. AND B.Sc. EXAMINATIONS.

MATRICULATION, INTERMEDIATE, FINAL.

PREPARATION by CORRESPONDENCE and ORAL TUITION on a THOROUGHLY INDIVIDUAL SYSTEM. Fees based on success.

The STAFF includes Graduates of Oxford, Cambridge, London, and Royal Universities, Science Medallists, Prizemen, Scholars, &c.

SINGLE SUBJECTS TAKEN: Latin, Greek, French, German, Mathematics, Science, Logic, Psychology, Political Economy, &c.

For terms, &c., address Mr. J. CHARLESTON, B.A. (Lond. and Oxon.), The Burlington Classes, 27 Chancery Lane, London, W.C.

INSTRUCTION IN PURE CULTIVATION OF YEAST.

According to HANSEN'S Methods.

Courses for Beginners, as well as for Advanced Students, in Physiology and Technology of Fermentations—Biological Analysis of Yeast.

Manuals:—E. Chr. Hansen: "Practical Studies in Fermentation." London (Spon), 1896. Alfred Jørgensen: "Micro-organisms and Fermentation." London (F. W. Lyon), 1893.

Further Particulars on Application to the Director, ALFRED JØRGENSEN, The Laboratory, Copenhagen, V.

Partner Wanted in a Scientific Manufacturing Business, with £1000 or upwards. Would suit Scientific Man or Son; exceptional opening; Capital wanted to carry out the Orders open, and—by enlarging Business—to avail of greatly increased trade waiting. Profits very large.—Address, "Scientific," care of NATURE Office.

SCIENCE MASTER WANTED, May 3,

for an Endowed School. University man looked for. Must be able to help with Lower Mathematics. Resident. Salary, £130 to £150 per Annum.—Apply P. T. O. GABBITAS, Thring & Co., 36 Sackville Street, London, W.

CHEMICAL LABORATORY STEWARD

REQUIRED for the Municipal Technical Institute, West Ham, E. Previous experience essential. Age not below 19. Wages, 27s. 6d. per Week, rising to 35s.—Apply by letter to the PRINCIPAL before April 18, giving particulars of previous experience.

W. G. PYE & CO.,

"GRANTA" WORKS, MILL LANE, CAMBRIDGE.

MAKERS OF PHYSICAL, PHYSIOLOGICAL, AND OTHER SCIENTIFIC INSTRUMENTS.

Sole Makers of Leake's Patent

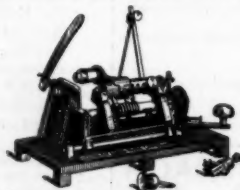
Flat-cutting Rocking Microtome.

Unsurpassed for ordinary work,

unequalled for Botanical work.

Price, as illustrated, in Case,

£8 6 0



LEAKE'S PATENT MICROTOME.

CAMBRIDGE PATTERN Rocking

Microtome, in Case, £3 5s.

Resistance Boxes from £3.

Improved Reflecting Galvanometers,

£3.

School Galvanometers from 10s. 6d.

PYE'S Improved Pattern Boyle's Law Apparatus ... £1 5 0 As shown at the recent Educational Exhibition at South Kensington with the Cambridge University Exhibits.
" " " Constant Volume Air Thermometer 0 15 0
" " " PRICE LISTS AND PAMPHLETS ON APPLICATION. (ILLUSTRATED CATALOGUE IN PREPARATION)

Apparatus for estimation of sulphur in spent oxide.

**FREDK. JACKSON & CO.**

(Late MOTTERHEAD & CO.),

14 CROSS STREET, MANCHESTER.

Goods Entrance: 10 Half-Moon Street,

LABORATORY FURNISHERS,

Importers, Manufacturers, and Dealers in

CHEMICAL AND PHYSICAL

APPARATUS

Of every Description.

Fine Chemicals, Volumetric Solutions,
Plain and Stoppered Bottles,

AND EVERY LABORATORY REQUIREMENT.

Illustrated Catalogue of Apparatus, with Price List of Chemicals, free on application.

Telegraphic Address—"APPARATUS, MANCHESTER."

Telephone Number—2038.

LETCHER & SONS (formerly Letcher Bros.),

SCIENTIFIC INSTRUMENT MAKERS,

25 TURNPIKE LANE, HORNSEY, N.

BLOWPIPE CABINETS. SPECIALITY: SOCIETY OF ARTS SETS.

PRICE LIST, POST FREE, ON APPLICATION.

T. TAMBLYN-WATTS, SCIENTIFIC APPARATUS MAKER.

Catalogue of Electrical Apparatus and Materials, 6d. Post free.
Catalogue of Balances and Weights, Apparatus for the Study of Mechanics, &c., 6d. Post free.

GOLDIELANDS, SETTLE, YORKS.

Now Ready. 8vo. Price 4s. net.

INORGANIC EVOLUTION

AS STUDIED BY

SPECTRUM ANALYSIS.

BY

SIR NORMAN LOCKYER, K.C.B., F.R.S.

MACMILLAN AND CO., LTD., LONDON.

FLAT SKELETONS OF SMALL ANI-

MALS AND BIRDS, made and mounted in Glass-topped Boxes, by Miss T. SMITH, Sladen Mount, Arnside, Westmoreland. Prices on application.

CO-OPERATIVE WORLD TRAVEL

Organised by HENRY S. LUNN, M.D., F.R.G.S.,
W. HOLDSWORTH LUNN & CONNOP F.S. PEROWNE.

A Cruise to the CENTRAL MEDITERRANEAN.

(MARSEILLES, PALMA, ALGIERS, MALTA, SICILY, CAPRI,
NAPLES, MARSEILLES.)

(Return Ticket to MARSEILLES included.)

AN EIGHTEEN DAYS' CRUISE FOR £21 0s. AND UPWARDS.

S.V. ARGONAUT. Tonnage, 3254; h.-p., 4000.

£10 10s. and £13 13s. TOURS TO ROME.

Extensions to NAPLES, FLORENCE, VENICE,
and the ITALIAN LAKES.

Full particulars from the Secretary, 5 Endsleigh Gardens,
Euston, London, N.W.

PHOENIX FIRE OFFICE,

9 LOMBARD ST., E.C., and 57 CHARING CROSS, S.W.

ESTABLISHED 1782.

MODERATE RATES. ABSOLUTE SECURITY.

ELECTRIC LIGHTING RULES SUPPLIED.

LIBERAL LOSS SETTLEMENTS.

PROMPT PAYMENT OF CLAIMS.

FRANCIS B. MACDONALD, SECRETARY.

LOSSES PAID OVER £22,000,000.

SECOND-HAND MICROSCOPES

By SWIFT, WATSON, CROUCH, BECK, ZEISS, LEITZ, &c.
Prices from £2 10s. to £45.

A Large Selection of Second-hand Powers and Fittings for all kinds of
Microscopes.

Send for New List.

CLARKSON & CO., 28 Bartlett's Buildings, Holborn Circus, E.C.

GLASS BLOWING.

All kinds of Experimental Glass
Blowing carried out for Scien-
tific Men, Laboratories, &c.

INVENTORS' IDEAS WORKED OUT AS PER
INSTRUCTIONS.

COSSOR,

67 Farringdon Road, E.C.



Shadow
Cross Tube.



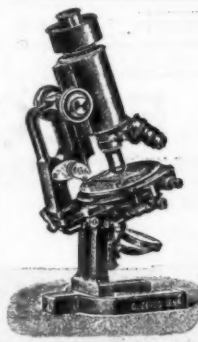
THE...
SMITH PREMIER
Typewriter..

Leads all other...
Writing Machines
in point of modern
improvements...
simple construc-
tion, and wearing
qualities.....

PURCHASERS of Smith Premier Type-
writers may be absolutely certain
they have the best writing machines
that can be turned out by a wise com-
bination of men, material, and money.

SEND FOR ART CATALOGUE, POST FREE.

The Smith Premier Typewriter Co.,
14 Gracechurch Street,
LONDON, E.C.



CARL ZEISS,

OPTICAL WORKS, JENA.

LONDON BRANCH:

29 MARGARET ST., REGENT ST., W.

NEW

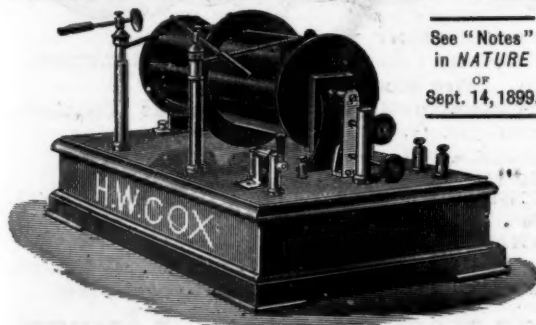
PHOTO-MICROGRAPHIC STAND

With very wide body-tube specially
designed for working with our MICRO-
PLANARS. It is also fitted with a new
Fine-Adjustment of great accuracy and
possessing a very slow movement.

These features render this Microscope
pre-eminently suitable for Photo-micro-
graphy with the highest and lowest powers,
as well as for ordinary visual observations.

DESCRIPTIVE PAMPHLET FREE ON APPLICATION.

X-RAY & ÆTHERIC TELEGRAPHY APPARATUS



See "Notes"
in NATURE

OF
Sept. 14, 1899.

OF THE HIGHEST QUALITY AND FINISH ONLY,
As supplied by us to H.M. Government and the leading
Hospitals and X-Ray Workers throughout the World.

We are the **actual Manufacturers**, and Guarantee
every Coil against breaking down.

CALL OR WRITE FOR OUR NEW ILLUSTRATED LIST, WITH
TESTIMONIALS AND ILLUSTRATED INSTRUCTIONS UPON HOW
TO WORK. POST FREE TO READERS OF "NATURE."

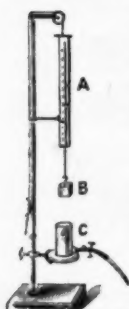
HARRY W. COX, Ltd.,

10, 11, 28 CURSITOR STREET,

CHANCERY LANE, LONDON.

Radiographs taken for Scientific and Medical Men, and
Demonstrations given.

MOORE'S HYDROSTATIC BALANCE



FOR ILLUSTRATING THE "PRINCIPLE OF ARCHIMEDES" AND SPECIFIC GRAVITY.

A is a delicate spring balance accurately graduated to read Grams, and is capable of being lowered or raised by the string shown.

B is one of the set of cubes of various metals supplied with the apparatus.

C is a glass vessel with fixed mark etched in glass, up to which water, or other liquid, is placed. The vessel is provided with draw-off cock.

Sole Makers of this Apparatus—

BREWSTER, SMITH, & CO.,

6 CROSS STREET, FINSBURY, E.C.

Manufacturers and Importers of Chemical and Scientific Apparatus and Pure Chemicals.

WEIGHTS a Speciality, 500 Milligrams to 1 Milligram, 12. 6d. per doz.

SEND FOR COMPLETE ILLUSTRATED CATALOGUE.

SPECTROPHOTOGRAPHY.

All requirements for Spectrophotography; Cameras of wood or metal adapted to any Spectroscope, and fitted with all necessary adjustments; Spectroscopes specially designed for photographic work.

Prisms and Lenses of Quartz, and Prisms of Iceland Spar for Photography of the Ultra-Violet Spectrum. Rowland's Diffraction Gratings always in stock.

ABSORPTION SPECTRA.

Bottle Prisms, with Quartz or Glass Plates; Schulze Cells; Double Slits, &c., for the study of Absorption Spectra.

THE ZEEMAN EFFECT.

Mr. HILGER is now making Michelson's "Echelon" Diffraction Gratings. The "Echelon" is the most powerful instrument yet devised for the minute analysis of fine spectral lines, and in particular for the observation of the Zeeman Effect.

A. HILGER, 204 Stanhope St., Hampstead Rd., London, N.W.

A REALLY SCIENTIFIC AND PRACTICAL NOVELTY.

THE "EVER READY" ELECTRIC TORCH

Shoots an **EXTREMELY POWERFUL** Light
into Dark Places.

**SIMPLICITY
ITSELF.**

No Wires.

No Chemicals.

No Danger.



THE MOST SERVICEABLE ELECTRIC LIGHT YET INVENTED.

MATCHES, TAPERS, CANDLES, HAND-LAMPS (Always a Danger) **ENTIRELY SUPERSEDED.**

No Leak—No Liquid. Wind Proof—No Flame. Fire Proof—No Heat.

No-Explosive—No Gas or Dangerous Chemicals.

A CHILD CAN USE IT.

Ready to pour a Flood of Light about your bedroom, along dark halls, stairways, and cellars, at any instant.

A SEARCH-LIGHT into Dark Corners unequalled for HOUSEHOLD PURPOSES.

PENETRATES all RECESSES, CUPBOARDS, and LOCKERS for HOUSEWIVES.

CHEAP. CLEAN. EFFECTIVE.

IT'S A USEFUL, HARMLESS BUSYBODY.

Size No. 1. Price (with Battery complete) 18s. Size No. 1. Extra Battery, 1s. 6d. Larger sizes, 25s. and 30s. each.

After 6000 to 8000 flashes then "refill" batteries can be slipped in at a moment's notice, and torch is as good as new.

W. & J. GEORGE, LTD., 33-37 HATTON WALL, LONDON.
(Late F. E. BECKER & CO.)

L. CASELLA, Scientific Instrument Maker, Engineer, &c.



THEODOLITES.

LEVELS.

SEXTANTS.

HORIZONS.

COMPASSES.

TELEMETERS.

TIDE GAUGES.

STEAM AND PRESSURE

GAUGES.

ANEROIDS.

&c., &c.

PARTICULARS AND PRICES MAY BE
HAD ON APPLICATION.

WRITE FOR DESCRIPTIVE PAMPHLETS AND CATALOGUES
OF SURVEYING INSTRUMENTS, &c.

**147 Holborn Bars,
LONDON, E.C.**

Telegraphic Address:—"ESCUTCHEON, LONDON."

Telephone:—No. 1054, HOLBORN.

ISENTHAL, POTZLER & CO.,

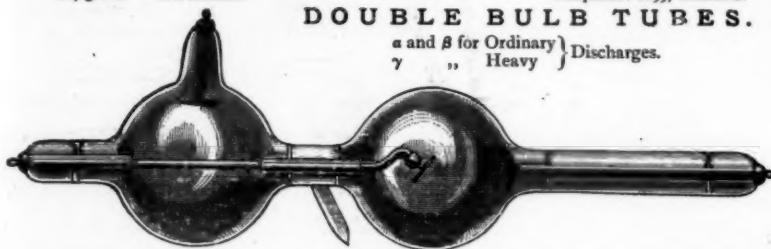
85 MORTIMER STREET, LONDON, W.

Teleggrams "HYSTERESIS."

Telephone: 3099, GERRARD.

DOUBLE BULB TUBES.

α and β for Ordinary } Discharges.
 γ " Heavy }



CENTRAL DEPÔT FOR RADIOGRAPHERS.

Write for Lists, or better
inspect our Installations.

HIGHEST REFERENCES.
EVERYTHING NOVEL AND
ORIGINAL.

SOLE AGENTS FOR SCOTLAND:
Messrs. JAMES WHITE,
Cambridge St., Glasgow.

An Invaluable Instrument for Alternate Current Work.

This Galvanometer has the shortest
periodic time of any Instrument
yet constructed, viz. 0.0001 Second,
is perfectly dead-beat and the self-
induction is practically nil.

Write for Descriptive Pamphlet.

SOLE MAKERS—

SCIENTIFIC INSTRUMENT CO.

LIMITED,

CAMBRIDGE.

DUDELL OSCILLOGRAPH

NEW SCIENCE LANTERN.

SOLE MAKERS:
REYNOLDS & BRANSON,
Ltd.

IMPROVED
PORTABLE
DESIGN.



The Universal Science Lantern has been devised for the projection of experiments. In the short box in front of the lantern is a hinged mirror, so placed that by the movement of a stud it may be introduced and placed at an angle of 45 degrees with the parallel beam. The beam is thus sent upwards through a horizontal convergent lens, on which a slide or horizontal piece of apparatus can be placed. Above this is the objective mounted on a brass pillar, and above the objective a prism or mirror (if the screen is elevated above the lantern plain prisms are required for each beam) silvered on the outside so that there is no double reflection. The mirror can be adjusted to any angle, and is intended to send the image in an approximately horizontal direction to the screen. Slides can also be directly projected in the usual way.

The base-board is made to fold so that the lantern can be packed into a box 18 1/2 x 8 1/2 x 2 1/2 with all its accessories *in situ*.

Price Complete, in Travelling Box. £9 0 0
REYNOLDS & BRANSON, LTD.
14 COMMERCIAL STREET, LEEDS.

A USEFUL COMPANION FOR THE SCIENTIFIC MAN.

Can be conveniently carried in the
pocket, and, therefore, always
handy for making notes.

Writes the moment it
touches the paper.

Can be used in
any position.

Has:—
A Nib of
14-carat Gold.

A Holder of the
Finest Vulcanised
Rubber.

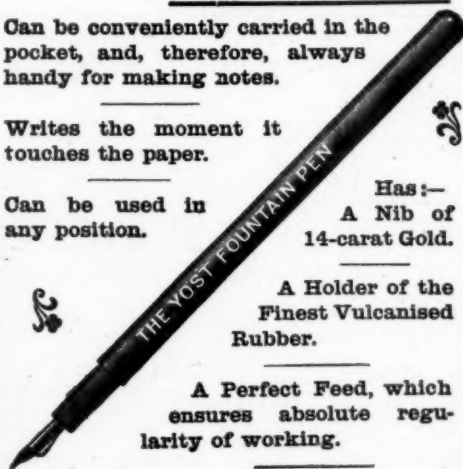
A Perfect Feed, which
ensures absolute regu-
larity of working.

Made in various styles, and with Nibs to
suit all hands.

"E" PRICE LIST SENT POST FREE.

The YÖST TYPEWRITER Co., Ltd.,
50 HOLBORN VIADUCT, LONDON, E.C.

WEST END DEPÔT:—303 Oxford Street.



LIVING SPECIMENS FOR THE MICROSCOPE.

Volvox, Spirogyra, Desmids, Diatoms, Amoeba, Arcella, Actinospherium, Vorticella, Stentor, Hydra, Floscularia, Stephanoceros, Melicerta, and many other Specimens of Pond Life. Price 12. per Tube, Post Free. Helix pomatia, Astacus, Amphioxus, Rana, Anodon, &c., for Dissection purposes.

THOMAS BOLTON,

25 BALSALL HEATH ROAD, BIRMINGHAM.

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM.

THE LABORATORY, PLYMOUTH.

The following animals can always be supplied, either living or preserved by the best methods:—

Sycon; Clava, Obelia, Sertularia; Actinia, Tealia, Caryophyllia, Alcyonium; Hormiphora (preserved); Leptoplana; Lineus, Amphiporus; Nereis, Aphrodite, Arenicola, Lanice, Terebella; Lepas, Balanus, Gammarus, Ligia, Mysid, Nebalia, Carcinus; Patella, Buccinum, Eledone, Pecten, Bugula, Crisia, Pedicellina, Holothuria, Asterias, Echinus; Ascidia, Salpa (preserved), Scyllium, Raja, &c., &c.
For prices and more detailed lists apply to Biological Laboratory, Plymouth.

THE DIRECTOR.

THE MOST NUTRITIOUS.

E P P S'S

GRATEFUL—COMFORTING.

C O C O A

BREAKFAST—SUPPER.

HOLLOWAY'S OINTMENT

CURES

Gout, Rheumatism, Lumbago, Sclaticea, Cuts, Bruises, Sprains, &c.

INVALUABLE FOR ALL SKIN DISEASES.

Holloway's Ointment and Pills may be obtained of all Medicine Vendors.

THE IRISH NATURALIST.

A Monthly Magazine of Irish Zoology, Botany, and Geology. Price 6d.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD PRAEGER, B.A.

Annual Subscription, 5s. Post Free to any Address.

Dublin: EASON & SON, LTD., 40 Lower Sackville Street (to which Address Subscriptions should be sent).

London: SIMPKIN, MARSHALL, HAMILTON, KENT, & CO., Ltd

WATKINS & DONCASTER,

NATURALISTS,

AND MANUFACTURERS OF

CABINETS AND APPARATUS

FOR ENTOMOLOGY, BIRDS' EGGS, AND ALL BRANCHES OF NATURAL HISTORY.

SPECIAL SHOW-ROOM FOR CABINETS.

Call or send for detailed Catalogue (86 pp.), Post free on application.

N.B.—For Excellence and Superiority of Cabinets and Apparatus, references are permitted to distinguished patrons, Museums, Colleges, &c.

A LARGE STOCK OF INSECTS AND BIRDS' EGGS.

Birds, Mammals, &c., Preserved and Mounted by First-class Workmen with true natural surroundings. All Books and Publications on Natural History supplied.

36 STRAND, LONDON, W.C.

(Five Doors from Charing Cross.)

MINERALS, ROCKS & FOSSILS.

COLLECTIONS FOR STUDENTS.

Carefully labelled and arranged in Boxes with Card Trays.

50 Minerals, 12/6; 100 do., 21/-; 200 do., 42/-.

Rocks and Fossils at similar prices.

300 Minerals in Cabinet, £4 4s.; 400 do., £5 12s. 6d.

Catalogues Post Free.

THOMAS D. RUSSELL.

78 NEWGATE STREET, LONDON, E.C.

THE SCIENTIFIC ROLL

AND MAGAZINE OF SYSTEMATIZED NOTES

METEOROLOGICAL SECTION.

CLIMATE: GENERAL. 4s.

CLIMATE: AQUEOUS VAPOUR. 6s. [Reprinting.

CLIMATE: BARIC CONDITION. Present Subscription Price, 10s.

The last No. is in Press.

To be followed by CARBONIC ACID, CHEMICAL RAYS, &c., to WIND.

O DRISCOLL, LENNOX & CO., 10 and 12 Elephant Road, Elephant and Castle, London, S.E.

THE ENTOMOLOGISTS' MONTHLY MAGAZINE.

Price Sixpence, Monthly

Edited by C. G. BARRETT, G. C. CHAMPION, F.Z.S., J. W. DOUGLAS, W. W. FOWLER, M.A., F.L.S., R. McLACHLAN, F.R.S., E. SAUNDERS, F.L.S., and

LORD WALSHINGHAM, M.A., LL.D., F.R.S.

This Magazine, commenced in 1864, contains standard articles and notes on all subjects connected with Entomology, and especially on the Insects of the British Isles.

Subscription—Six Shillings per Annum, post free.

London: GURNEY & JACKSON (Mr. Van Voorst's Successors), 1 Paternoster Row.

SCIENTIFIC WORTHIES.

The following is a list of the Steel Portraits that have appeared in the above Series:—

MICHAEL FARADAY.
THOMAS HENRY HUXLEY.
CHARLES DARWIN.
JOHN TYNDALL.
SIR GEORGE GABRIEL STOKES.
SIR CHARLES LYELL.
SIR CHARLES WHEATSTONE.
SIR WYVILLE THOMSON.
ROBERT WILHELM BUNSEN.
LORD KELVIN.
BARON ADOLF ERIK NORDENSKJÖLD.

HERMANN L. F. HELMHOLTZ.
SIR JOSEPH DALTON HOOKER.
WILLIAM HARVEY.
SIR GEORGE B. AIRY.
J. LOUIS R. AGASSIZ.
JEAN BAPTISTE ANDRÉ DUMAS.
SIR RICHARD OWEN.
JAMES CLERK MAXWELL.
JAMES FRESKOT JOULE.
WILLIAM SPOTTISWOODE.
ARTHUR CAYLEY.
SIR C. W. SIEMENS.

JOHN COUCH ADAMS.
JAMES JOSEPH SYLVESTER.
DMITRI IVANOWITSH MENDELÉEF.
LOUIS PASTEUR.

SIR ARCHIBALD GEIKIE.
LORD LISTER.
STANISLAO CANNIZZARO.
PROF. VON KÖLLIKER.
PROF. SIMON NEWCOMB.

N.B.—The Portraits of Sir A. Geikie, Lord Lister, Prof. Cannizzaro, Prof. von Kölliker, and Prof. S. Newcomb belong to a New Series and are Photogravures.

Proof impressions of these, printed on 'India' paper, may be had from the Publishers, price 5s. each; or the Series of 32 Portraits in a Handsome Portfolio for £8 5s., carriage paid. The Portfolio may be had separately, price 6s.

Cheques and Money Orders payable to MACMILLAN & CO., Limited.

OFFICE OF "NATURE," ST. MARTIN'S STREET, LONDON, W.C.

MACMILLAN & CO.'S NEW AND RECENT BOOKS FOR STUDENTS OF ZOOLOGY.

AN ELEMENTARY COURSE OF PRACTICAL ZOOLOGY.

By the late **T. JEFFERY PARKER**, D.Sc., F.R.S., Professor of Biology in the University of Otago, Dunedin, New Zealand, and **W. NEWTON PARKER**, Ph.D., Professor of Zoology at the University College of South Wales and Monmouthshire, in the University of Wales. With 156 Illustrations. Crown 8vo. 10s. 6d.

LANCET.—"Will be found serviceable to the upper classes of schools where natural history is taught, and to classes for elementary biology in medical schools."

A MANUAL OF ZOOLOGY.

By the late Prof. T. J. PARKER, D.Sc., F.R.S., and Prof. W. A. HASWELL, M.A., D.Sc., F.R.S.
With Three Hundred Illustrations. Crown 8vo. 10s. 8d.

ZOOLOGIST.—"The present publication may be considered a condensation of the previous work ('A Text-Book of Zoology'). . . . Thus we have the essence of a really good book in a convenient form for teachers and students."

FIELD.—"For those who require a manual to assist them in acquiring an accurate knowledge of zoology we know of no book superior to that under notice. . . . The illustrations are admirable. We know of no work better fitted to fulfil the purpose for which it was designed than the one under notice. It is an admirable introductory text-book to scientific zoology."

A TEXT-BOOK OF ZOOLOGY.

By T. JEFFERY PARKER, D.Sc., F.R.S.,

Professor of Biology in the University of Otago, Dunedin, N.Z., and WILLIAM A. HASWELL, M.A., D.Sc., F.R.S., Professor of Biology in the University of Sydney, N.S.W. In Two Vols. With Illustrations. Medium 8vo, 36s. net.

SCIENCE PROGRESS.—"The appearance of this important work, for which many of us have been eagerly waiting, will be hailed with pleasure. . . . When we consider the difficulties under which these authors laboured, one in New Zealand the other in Sydney, the printers, publishers and artists in England, one can only marvel at the splendid work they have produced, one that will be useful both to the elementary and advanced student alike, as well as to the teacher."

THE CAMBRIDGE NATURAL HISTORY.

EDITED BY S. F. HARMER, M.A., AND A. E. SHIPLEY, M.A.

TO BE COMPLETED IN TEN VOLUMES. 8VO. PRICE 17S. NET EACH.

WORMS, LEECHES, &c.

VOLUME II.

Flatworms. By F. W. GAMBLE, M.Sc. Vict., Owens College. Nemertines. By Miss L. SHELDON. Threadworms, &c. By A. E. SHIPLEY, M.A. Rotifers. By Professor MARCUS HARTOG, M.A., D.Sc. Lond. Polychaet Worms. By W. BLAXLAND BENHAM, D.Sc. Lond., Hon. M.A. Oxon. Earthworms and Leeches. By F. E. BEDDARD, M.A. Oxon., F.R.S. Gephyrea, &c. By A. E. SHIPLEY, M.A. Polyzoa. By S. F. HARMER, M.A.

NATURE.—"Taken as a whole the book is fully worthy of its place in this attractive series."

SHELLS.

VOLUME III.

Molluscs and Brachiopods. By the Rev. A. H. COOKE, M.A., A. E. SHIPLEY, M.A., and F. R. C. REED, M.A.

FIELD.—"We know of no book available to the general reader which affords such a vast fund of information on the structure and habits of molluscs."

INSECTS & CENTIPEDES.

VOLUME V.

Peripatus. By ADAM SEDGWICK, M.A., F.R.S. Myriapods. By F. G. SINCLAIR, M.A. Insects. Part I. By DAVID SHARP, M.A. Cantab., M.B. Edin., F.R.S.

ATHENÆUM.—"This book will find a place in the library of most entomologists, prove a welcome boon to weak brethren who are compelled to lecture—*docendo discimus*—and occupy by the side of Westwood's 'Modern Classification' and 'Burmester's Manual' a niche that has long been empty."

INSECTS.

VOLUME VI.

Part II. Hymenoptera continued (Tubulifera and Aculeata), Coleoptera, Strepsiptera, Lepidoptera, Diptera, Aphaniptera, Thysanoptera, Hemiptera, Anoplura. By DAVID SHARP, M.A. Cantab., M.B. Edin., F.R.S.

ENTOMOLOGIST'S RECORD.—"Too much cannot be said in praise of this work, which offers to the general naturalist, as well as to the specialist, a thoroughly reliable text-book that is distinctly in advance of any other work of a similar kind yet published in the English language."

BIRDS.

VOLUME IX.

By A. H. EVANS. With numerous Illustrations by G. E. LODGE.

NATURE NOTES.—"We venture to predict that, of the ten volumes of which this excellent series is planned to consist, none will secure a wider popularity than Mr. Evans' treatise on birds. Strange as it may appear, among the many books on birds that have appeared of late years, we do not recall any that covers the same ground. . . . We are grateful to the author for the mine of valuable information which he has crowded between his two covers."

* * * The remaining five volumes, dealing with PROTOZOA (including Sea Anemones, Jelly Fish, Star Fish, &c.); SPIDERS, SCORPIONS, and CRUSTACEA; FISHES and THEIR KINDRED; AMPHIBIA and REPTILES; and MAMMALS, are all in active preparation.

MACMILLAN AND CO., LIMITED, LONDON.

MACMILLAN & CO.'S NEW SCIENTIFIC BOOKS.

MICRO-ORGANISMS AND FERMENTATION.

By ALFRED JÖRGENSEN,

Director of the Laboratory for the Physiology and Technology of Fermentation at Copenhagen. Translated by ALEX. K. MILLER, Ph.D., F.I.C., and A. E. LENNHOLM. Third Edition, completely Revised. With 83 Illustrations. 8vo. 10s. net. [Just ready.]

TEXT-BOOK OF PALÆONTOLOGY.

By KARL A. VON ZITTEL,

Professor of Geology and Palæontology in the University of Munich. Translated and Edited by CHAS. R. EASTMAN, Ph.D., Assistant in Palæontology in the Museum of Comparative Zoology at Harvard. With 1476 Woodcuts. Medium 8vo. 25s. net.

* * This English Edition is revised and enlarged by the Author and Editor in collaboration with numerous Specialists.

SPEAKER.—"In this sphere Prof. Zittel's books have long held the field as the standard works of their class, but to many they have been inaccessible on account of their being in a foreign tongue. . . . It has not merely been translated; it has been edited and brought up to date as well. . . . The author and editor have conferred a great boon upon their fellow-workers, whether English or foreign, by bringing out what is really a new edition of this work. . . . A most valuable addition to the scientific literature of the world, and the publication of the second volume, dealing with the Vertebrata, will be awaited with the keenest interest on all sides."

ENLARGED AND REVISED EDITION NOW READY.

LESSONS IN ELEMENTARY PHYSIOLOGY.

BY THOMAS H. HUXLEY, LL.D., F.R.S.

Enlarged and Revised Edition. Globe 8vo. 4s. 6d.

VOL. III. (COMPLETING THE WORK) NOW READY.

DICTIONARY OF POLITICAL ECONOMY. Edited by R. H. INGLIS PALGRAVE.

Vol. III. (completing the work). Medium 8vo, 21s. net. Also ready, Vols. I and II., 21s. net each.

ECONOMIC JOURNAL.—"The list of contributors is a brilliant one. They have played their parts well, and the editor has managed them with great ability. . . . If its success is at all commensurate with its deserts, the publishers may congratulate themselves upon a very valuable venture. No working economist can afford to be without this dictionary. Mr. Palgrave's dictionary emerges successfully from the severe test of comparison with its French and German predecessors."

DEMOCRACY AND EMPIRE, WITH STUDIES OF THEIR PSYCHO-

LOGICAL, ECONOMIC, AND MORAL FOUNDATIONS. By FRANKLIN HENRY GIDDINGS, M.A., Ph.D., Professor in Columbia University, New York. 8vo. 8s. 6d. net.

SPEAKER.—"The actuality in Professor Giddings' political philosophy, the vigour of his style, and the choice of his subjects, are likely to win him a large audience. And his point of view deserves careful study."

MONOPOLISTS AND TRUSTS. By RICHARD T. ELY, Ph.D., LL.D., Professor

of Political Economy and Director of the School of Economics, Political Science, and History in the University of Wisconsin. Crown 8vo. 5s. net. [The Citizen's Library.]

INTRODUCTION TO PHYSICAL CHEMISTRY. By JAMES WALKER, D.Sc.,

Ph.D., Professor of Chemistry in University College, Dundee. 8vo. 10s. net.

GUARDIAN.—"It is with great satisfaction that we welcome the appearance of this valuable text-book. . . . It is the most important purely English work of the kind that has yet appeared. . . . The best introduction to physical chemistry at present available."

THE THEORY OF ELECTROLYTIC DISSOCIATION AND SOME OF

ITS APPLICATIONS. By HARRY C. JONES, Associate in Physical Chemistry in Johns Hopkins University. Extra crown 8vo. 7s. net.

SPECTATOR.—"An interesting study. . . . It is written easily, the historical sequence of the experiments is preserved, and, finally, it proves that a purely scientific subject can be treated with style and simplicity if the writer keeps in view his real aim, the instruction of others."

THE PHYSICAL REVIEW.

A JOURNAL OF EXPERIMENTAL AND THEORETICAL PHYSICS.

CONDUCTED BY EDWARD L. NICHOLS, ERNEST MERRITT, AND FREDERICK BEDELL.

No. 2, VOL. X., FEBRUARY, 1900. PRICE 3s. NET.

CONTENTS.—The Influence of Electrification on the Surface Tension of Water and Mercury. By Ernest Merritt and Samuel J. Barnett.—An Objective Representation of the Hysteresis of Iron and Steel. By Knut Ångström.—A Determination of the Nature of the Electric and Magnetic Quantities, and of the Density and Elasticity of the Ether. II. By Reginald A. Fessenden.—Thermodynamic Notes (No. 10); Revision of some Thermal Data concerning Benzene. By K. Tsuruta.—An Efficient Boyle's Law Apparatus. By W. J. Humphreys.—New Books.

MACMILLAN AND CO., LIMITED, LONDON.

MINERALOGY.

Micro. Slides, Collections and Single Specimens of Minerals, Rocks and Precious Stones, for the Student, Teacher and Prospector.
Elementary Collections in Case, 40 Specimens in Case, 6s. Blowpipe Cases and all necessities for Field or Class Work.

LESSONS GIVEN.

SAMUEL HENSON,
97 REGENT STREET, LONDON, W.
ESTABLISHED 1840.

PHYSIOGRAPHY and GEOLOGY.**COLLECTIONS & MICROSCOPIC SLIDES,**

As advised by Science and Art Directory, arranged by

JAMES R. GREGORY & CO.,
Mineralogists, &c.

To Science and Art Department, British, Indian and Colonial Museums, &c.

NOVELTIES and RARE GEMS and PRECIOUS STONES.

Mineral Specimens for Museums, and Collectors, and all purposes.
Rock Specimens and Microscopic Sections of Rocks and Minerals cut to order.

NEW AND VALUABLE MINERAL SPECIMENS CONSTANTLY ARRIVING.

Stores & Offices: **1 Kelso Place, KENSINGTON, W.**

NEW CATALOGUES AND LISTS FREE.

ESTABLISHED 1851.

BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

INVESTED FUNDS**£10,000,000.**

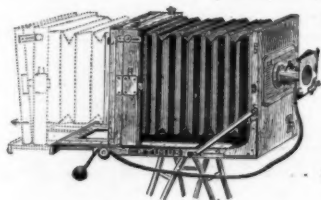
The BIRKBECK ALMANACK, with full particulars, post free.

FRANCIS RAVENSCROFT, *Manager.***TO SCIENCE LECTURERS.****HUGHES' MOTO-PHOTOSCOPE FOR LIVING PICTURES.**

THE MOST PERFECT.

No SHUTTER, therefore no Flickering. Superb Mechanism.

The Moto-Photo Camera for taking the Pictures. Illustrated Lists, ad. See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN, &c. Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great success. New Oxyhydrogen Microscope. Science Lanterns for Class Demonstration. Magnificent Results. Docwra Triple, Prize Medals Highest Award. Supplied to the Royal Polytechnic Institution, Dr. H. GRAY-TAN GUINNESS, Madame ADELINA PATTI, &c., &c. Patent Pamphengo, Science Lanterns. The Universal Lantern 4-inch Condensers, 4-wick Lamp, Portrait Combination front Lenses, 18s. 6d., Marvellous value. Science Lecture Sets. Novelities. The Lantern Kaleidoscope. Cheapest Lantern Outfits in the World. Grandly Illustrated Catalogue, over 180 choice Engravings, 6d.; Postage, 3d. List of 300 Lecture Sets, Science Subject Views, &c., 6d.; Postage 2d. Pamphlets Free. W. C. HUGHES, SPECIALIST, Brewster House, 88 Mortimer Road, Kingsland, N.

TRADE
MARK**"OPTIMUS."**TELEGRAPHIC
ADDRESS.**PHOTOGRAPHIC
APPARATUS**OF BEST WORKMANSHIP
FOR ALL PURPOSES.

Catalogue POST FREE.

PERKEN, SON & CO., LTD., 99, HATTON GARDEN, **LONDON.**
HOLBORN CIRCUS, E.C.

HARVEY & PEAK

(BY APPOINTMENT TO THE ROYAL INSTITUTION OF GREAT BRITAIN)

HAVE FOR DISPOSAL A NUMBER OF**NICOL PRISMS AND TOURMALINES** of various Sizes.

PROJECTION POLARISCOPES of various Sizes in Stock, with large Nicol Prisms:—
STUDENTS' SPECTROMETERS.—P. O. Bridge Sets, for Schools.—Induction Coils.—Wimshurst Machines.—
X-Ray Apparatus.—Optical Banks, &c., &c.

*H. & P. are the actual Manufacturers of the above.***56 CHARING CROSS ROAD, LONDON, W.C.**

NOTICE.—Advertisements and business letters for NATURE should be addressed to the Publishers; Editorial communications to the Editor. The telegraphic address of NATURE is "PHUSIS," LONDON.

SUBSCRIPTIONS TO "NATURE."

	£	s.	d.
Yearly	1	8	0
Half-yearly	0	14	6
Quarterly	0	7	6
TO ALL PLACES ABROAD:—			
Yearly	1	10	6
Half-yearly	0	15	5
Quarterly	0	8	0

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
*Three Lines in Column	0	2	6
Per Line after	0	0	9
One Eighth Page, or Quarter Column	0	18	6
Quarter Page, or Half a Column	1	15	0
Half a Page, or a Column	3	5	0
Whole Page	6	6	0

*The first line being in heavy type is charged for as Two Lines.

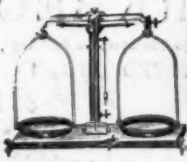
Cheques and Money Orders payable to **MACMILLAN & CO., Limited.**

OFFICE: ST MARTIN'S STREET, LONDON, W.C.



HARRIS' ORIGINAL PATTERN ATWOOD MACHINE. 4002A. Accurate and Reliable, 8 to 9 feet high, graduated, £3 12s.

HARRIS' SPECIALITIES.—CATALOGUES UPON APPLICATION.



Reliable Balances. 7250A. 100 grm. to 1 mgm. Agate Planes and Knife Edges. £1 9s. 6d.; Steel £1 4s.



Resistance Box, Post Office, £6 res. 4775A.



New Mechanical Apparatus. See List.



Stroud and Rendell Lantern, £5. 6029A.

PHILIP HARRIS & Co., LTD.,

COMPLETE LABORATORY FURNISHERS, BIRMINGHAM.

Telegraphic Address : "Science," Birmingham. Telephone No. 10.

WATSON'S NEW MICROSCOPES AND APPARATUS.



WATSON'S HOLOSCOPIC EYEPIECES, for use with either APOCHROMATIC or ACHROMATIC OBJECTIVES, an adjustment being provided to the special lenses employed, for altering the correction. There is no sacrifice of efficiency, the performance being equal to the most expensive Compensating or Huyghenian Oculars.

Magnifying Powers—

6 in. tube length, 5, 7, 10, and 14 diameters. 10 in. " 7, 10, 14, and 20 "

PRICE, in Student's Size and Pattern, either power, 17/6 each.

For Full Particulars see Supplemental List, Post Free.

WATSON'S Parachromatic OIL IMMERSION CONDENSER.

Total aperture, 1.30; applanatic aperture exceeds 1.25. Undoubtedly the finest Condenser obtainable for high-power work. Optical part only ... £5 0 0

Completely mounted with Iris Diaphragm and Set of Stops ... £8 10 0

WATSON'S "SCHOOL" MICROSCOPE, New Model, complete with 1 in. Objective, in Case ... £3 3 0

WATSON'S "ROYAL" MICROSCOPE. A new model high-class instrument.

WATSON'S "FRAM" MICROSCOPE. A highest-class instrument at a very moderate cost.

BACTERIOLOGICAL APPARATUS. MICROTOMES. Apparatus for FIELD BOTANY and FIELD GEOLOGY. METAMORPHOSES and DISSECTED PREPARATIONS. BOTANICAL and PHYSIOLOGICAL MODELS.

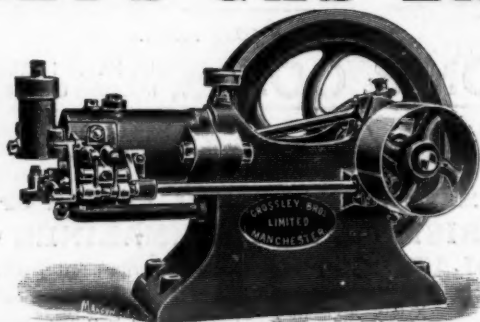
For Particulars of all the above, see Watson's New Supplemental List to Catalogue No. 2, Post Free on application.

Watson's Catalogue (No. 2) is a Classified List representing a Stock of 40,000 first-class Micro-Slides, Post free on application.

W. WATSON & SONS (Established 1837), Opticians to H.M. Government. 313 HIGH HOLBORN, LONDON, W.C. New Branch Now Open : 16 FORREST ROAD, EDINBURGH. And at 78 Swanston Street, Melbourne, Australia. Awarded 39 Gold and other Medals at the principal International Exhibitions of the World.

CROSSLEY'S GAS ENGINES.

RECENTLY
REMODELLED.



GREAT
REDUCTION
IN
GAS
CONSUMED.

CROSSLEY BROS., LTD., OPENSHAW, MANCHESTER.

THE NEW STIGMATIC LENS.

SERIES II. F/6.

BRITISH DESIGN AND WORKMANSHIP.

Is the best All-round Lens for either Professional or Amateur use.

Each lens will give perfect definition with full aperture to the extreme corners of the plate it is sold to cover; with smaller stops it will cover at least two sizes larger, giving perfect sharpness all over the plate, and thus becoming a wide-angle lens of the highest excellence. Either combination may be used separately, giving foci of about 1½ and 2 times the length of that of the lens when used intact. The advantage of thus being able to choose the best point of view, irrespective of distance, will be at once apparent to the artistic worker.

EQUIVALENT TO FOUR LENSES AT THE PRICE OF ONE.

Eleven Sizes are now ready from 3¼ to 18 inches eq. focus.

CATALOGUE OF HIGH-CLASS CAMERAS AND LENSES, POST FREE.

J. H. DALLMEYER, Ltd., 25 NEWMAN STREET, OXFORD STREET, LONDON, W.

Printed by H. AND C. LAY AND SONS, LIMITED, at 7 & 8 Broad Street Hill, Queen Victoria Street, in the City of London and published by MACMILLAN AND CO. LIMITED, at St. Martin's Street, London, W.C., and THE MACMILLAN COMPANY, 66 Fifth Avenue, New York.—THURSDAY, April 5, 1900.



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

No. 1589; VOL. 61]

THURSDAY, APRIL 12, 1900.

[PRICE SIXPENCE.

Registered as a Newspaper at the General Post Office.]

[All Rights are Reserved.

WIRELESS TELEGRAPHY.

The "APPS-NEWTON" INDUCTION COILS have proved far superior to all others in telegraphing long distances without wires.

They were used in the Government Experiments at Penarth and Dover; also by Signor Marconi and the Wireless Telegraph Company in telegraphing to and from the Goodwin Lightship, and across the Channel; at the British Association Meeting at Dover for telegraphing to France; and at the Naval Manœuvres, where a distance of sixty miles was covered, &c.

After prolonged tests the "Apps-Newton" Coils have been adopted by the Wireless Telegraph Company, by the War Office and by the Admiralty; several have been sent to the Front in South Africa, and the ships of the Channel Squadron are now being fitted with them.

PRICES ON APPLICATION.

SOLE MAKERS:

NEWTON & CO.,

Scientific Instrument Makers to H.M. the Queen
and the Government,

3 FLEET STREET, LONDON, E.C.

GRIFFIN'S NEW FORM OF APPARATUS
For the ABSOLUTE

EXPANSION OF SOLIDS

(Weedon's Patent).



One great merit in the design of this Apparatus is that it is a purely Mechanical method, and does not depend at all upon Optical methods of magnification that so frequently are a difficulty in early Practical Physics work. The measurement reduces itself to the readings of two *Micrometer Screws*.

A DIRECT MECHANICAL METHOD.

ABSOLUTE READINGS OBTAINED.

SIMPLEST DESIGN.

Write for Particulars and Specimen Curves obtained.

SOLE MAKERS:

JOHN J. GRIFFIN & SONS, L^d
20-26 SARDINIA STREET, LONDON, W.C.

By the Late Dr. ST. GEORGE MIVART.

THE GROUNDWORK OF SCIENCE.

Large 8vo, Cloth extra, 6s.

"His firm grasp of logical principles, steady insight, and clear reasonableness, eminently fit him for the task of exposing the fallacies of light scepticism, and quibbling cranks of the imagination."—*Tablet*.

"We can do little more, in the limits of newspaper space, than announce, with a cordial welcome, a new and important work by Prof. St. George Mivart. . . . This is strictly a treatise on mental science, and proves once again the philosophic power of a thinker who has done so much as an observer and as a judge of evidence."—*Weekly Register*.

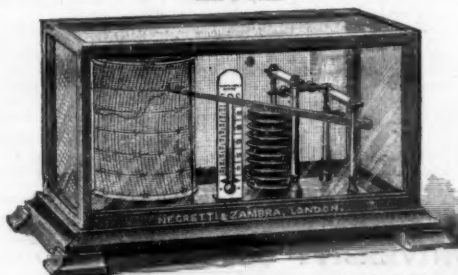
The late Dr. St. George Mivart, in a letter written a few weeks ago, said:—

"My last work, 'The Groundwork of Science,' has undergone no ecclesiastical supervision, my convictions, when I wrote it, being almost fully what they now are."

JOHN MURRAY, ALBEMARLE STREET, W.

NEGRETTI & ZAMBRA'S Self-Registering
Barometers, Thermometers and Rain Gauges.

Giving continuous Records on Charts, and only requiring attention once a week.



THE LARGE SIZE BAROGRAPH, £7 10 0

Accurate Thermometers for all purposes.

Illustrated Price List of Instruments free by post to all parts of the World.

38 HOLBORN VIADUCT, E.C.

BRANCHES—45 CORNHILL, and 122 REGENT STREET.

ROYAL INSTITUTION OF GREAT BRITAIN,

ALBEMARLE STREET, PICCADILLY, W.

LECTURE ARRANGEMENTS—AFTER EASTER, 1900.

LECTURE HOUR, 3 O'CLOCK P.M.

HUGH ROBERT MILL, Esq., D.Sc., LL.D., F.R.S.E., Librarian Royal Geographical Society. Three Lectures on "Studies in British Geography: (1) The English Lakes; (2) The Clyde Sea Area; (3) A Corner of Sussex. On Tuesdays, April 24; May 1, 8. Half-a-Guinea the Course.

ALEXANDER HILL, M.A., M.D., Master of Downing College, Cambridge. Two Lectures on "Brain-tissue considered as the Apparatus of Thought." (Illustrated by Photomicrographs of Brain-tissue.) On Tuesdays, May 15, 23. Half-a-Guinea.

R. WARWICK BOND, Esq., M.A. Two Lectures on (1) "Ruskin, Man and Prophet; (2) Ruskin, the Servant of Art." On Tuesdays, May 29; June 5. Half-a-Guinea.

PROF. DEWAR, M.A., LL.D., F.R.S., M.R.I., Fulleren Professor of Chemistry, R.I. Four Lectures on "A Century of Chemistry in the Royal Institution." On Thursdays, April 26; May 3, 10, 17. Half-a-Guinea.

THE REV. CANON AINGER, M.A., LL.D. Three Lectures on "Chaucer." On Thursdays, May 24, 31; June 7. Half-a-Guinea.

STANLEY LANE-POOLE, Esq., M.A. (Oxon), Professor of Arabic at Trinity College, Dublin. Two Lectures on "Egypt in the Middle Ages." On Saturdays, April 28; May 5. Half-a-Guinea.

ALFRED HILLIER, M.D., B.A. Two Lectures on "South Africa; Past and Future." On Saturdays, May 12, 19. Half-a-Guinea.

SIR FREDERICK BRIDGE, Mus. Doc., Organist of Westminster Abbey, and Gresham Professor of Music. Three Lectures on "The Growth of Chamber Music, from Allegri's Symphonia (1580-1652) to Haydn's First Quartet" (with Musical Illustrations). On Saturdays, May 26; June 2, 9. Half-a-Guinea.

Subscription (to Non-Members) to all Courses of Lectures (extending from Christmas to Midsummer), Two Guineas. Tickets issued daily at the Institution, or sent by post on receipt of Cheque or Post-Office Order.

Members may purchase not less than Three Single Lecture Tickets, available for any Afternoon Lecture, for Half-a-Guinea.

The Friday Evening Meetings will be resumed on April 27, at 9 p.m., when the RIGHT HON. LORD KELVIN will give a Discourse on "Nineteenth Century Clouds over the Dynamical Theory of Heat and Light." Succeeding Discourses will probably be given by Prof. T. E. THORPE, SIDNEY LEE, Esq., Prof. J. A. EWING, FRANCIS FOX, Esq., SIR HENRY ROSCOE, and other Gentlemen. To these Meetings Members and their Friends only are admitted.

Persons desirous of becoming Members are requested to apply to the SECRETARY. When proposed they are immediately admitted to all the Lectures, to the Friday Evening Meetings, and to the Library and Reading Rooms; and their Families are admitted to the Lectures at a reduced charge. Payment: First Year, Ten Guineas; afterwards, Five Guineas a Year; or a composition of Sixty Guineas.

THE MIDDLESEX HOSPITAL MEDICAL SCHOOL,

(CLOSE TO OXFORD CIRCUS), LONDON, W.

The SUMMER SESSION, 1900, will commence on Tuesday, May 1. Full opportunities for study are offered to Students preparing for any of the Examinations in Medicine and Surgery in the United Kingdom.

Classes will be held in the following subjects:—Midwifery, Pathology, Pathological Histology, Bacteriology, Forensic Medicine and Public Health, Anatomy, Practical Physiology and Histology, Chemistry and Practical Chemistry, Materia Medica, Therapeutics, Psychological Medicine with Clinical Demonstrations, Practical Pharmacy.

Students entering in May are eligible to compete for the Entrance Scholarships (value £100 and £60) awarded at the commencement of the ensuing Winter Session. The Broderip Scholarships, Governors' Prize, Hetley Prize, Lyell Medal, Leopold Hudson Prize, and Freeman Scholarship, are awarded annually. The Murray Scholarship (in connection with the University of Aberdeen) every third year. Eighteen resident appointments are open for competition annually, without fee.

The composition fee, admitting to the whole curriculum, is 135 guineas; if paid in three instalments, first instalment 60 guineas.

For University of London Students requiring Preliminary Science Instruction, 150 guineas, or by instalments. For members of Universities recognised by the General Medical Council, and other Students who have completed their Anatomical and Physiological studies, the fee for admission as General Students is 70 guineas, or by instalments, 75 guineas. Students from the Universities of Oxford and Cambridge entering in May are eligible to compete for the University Scholarship of £60 awarded at the commencement of the Winter Session. Fee for Dental Students, 54 guineas.

New Laboratories and Class-rooms for Physiology, Chemistry, Biology, Pathology, Bacteriology, with all modern improvements as well as a new and larger Dissecting Room and Operative Surgery Room are now in regular use.

The Residential College contains accommodation for Thirty Students. For Prospectus and further Particulars, apply to

W. PASTEUR, M.D., Dean.

UNIVERSITY COLLEGE, LONDON.

FACULTIES OF ARTS AND LAWS AND OF SCIENCE.

DEANS:

Professor W. P. KER, M.A., LL.D. (Arts and Laws).

Professor VAUGHAN HARLEY, M.D. (Science).

The Third Term begins Tuesday, April 24th.

For prospectus, &c., apply to

J. M. HORSBURGH, M.A., Secretary.

ST. MARY'S HOSPITAL MEDICAL SCHOOL,

PADDINGTON, W.

The SUMMER SESSION will BEGIN on May 1st.

The Hospital is in close proximity to Paddington Station, Great Western Railway, to the terminus of the Great Central Railway, and to several stations of the Metropolitan and District Railways. The School provides complete preparation for the Higher Examinations and Degrees of the Universities. The Hospital affords great facilities for all branches of clinical study. The numerous clinical appointments in the Hospital are free to all students, and the resident medical appointments are awarded by competitive examination.

The NEW OUT-PATIENTS' DEPARTMENT in the Clarence Memorial Wing, with its extensive accommodation and modern equipment, possesses exceptional advantages for clinical work.

ENTRANCE SCHOLARSHIPS IN NATURAL SCIENCE.—One of £144, two of £78 15s., one of £52 10s., two of £37 15s. (for students from Oxford and Cambridge) will be awarded by Examination in September.

SPECIAL TUITION is provided for the various Examinations of the Universities of Oxford, Cambridge, and London, for the Fellowship of the Royal College of Surgeons, and for all the Final Examinations, without additional fees.

IMPROVED LABORATORIES.—The Physiological Laboratories have been further extended, and a Special Physiological Lecture Room for advanced practical classes has been added. New Pathological and Bacteriological Laboratories have also recently been provided, and the Chemical Laboratory enlarged.

PRELIMINARY SCIENTIFIC COURSE.—Special Classes, including Lectures and Laboratory Work, are held throughout the year. The prospectus, containing particulars of fees, &c., may be had on application to the Secretary.

H. A. CALEY, M.D., Dean.

GUY'S HOSPITAL MEDICAL SCHOOL.

The SUMMER SESSION will begin on May 1, and Students then entering will be eligible to compete for Entrance Scholarships of the combined value of £410 in the following September, as well as for the numerous Medals, Scholarships, and Prizes awarded during the period of Studentship.

The Hospital contains accommodation for 644 beds, and arrangements are being made as rapidly as possible to place the entire number at the service of the sick poor, by reopening the Wards that have been closed for want of funds for the last fifteen years.

The Appointments tenable by Students have recently been increased by more than 150 a year, chiefly by the addition of Clerkships and Dresserships in the departments of Ophthalmology, Gynaecology, and Otology.

To augment the teaching of special subjects, Registrars and Tutors have been appointed in the Ophthalmic and Obstetric Departments.

All Hospital Appointments are open to Students without charge, and the holders of Resident Appointments are provided with board and lodging.

The College accommodates 60 Students, under the supervision of a Resident Warden.

The Dental School provides the full Curriculum required for the L.D.S. England.

The Clubs' Union Athletic Ground is easily accessible.

A Handbook of Information for those about to enter the Medical Profession will be forwarded on application.

For the Prospectus of the School, containing full particulars as to Fees, Course of Study advised, Regulations for Residents in the College, &c., apply personally, or by letter to the DEAN, Guy's Hospital, London Bridge, S.E.

GLASGOW ROYAL INFIRMARY.

The SUMMER SESSION opens on APRIL 24, 1900. The number of beds, including the Ophthalmic Department, is 612.

Special Wards and Beds are set apart for the treatment of the Diseases of Women, of the Throat and Nose and of the Ear; and there is a specially well-equipped department for the treatment of Diseases and Injury of the Eye. Women Students are admitted to the Clinical Teaching and Practice of the Infirmary; Medical and Surgical Wards being set apart for their exclusive use.

HOUSE APPOINTMENTS.—Five House Physicians and Seven House Surgeons are elected every six months, and an Assistant to the Gynaecologist, who boards but is non-resident, is elected at the same time. Women are eligible for this appointment.

Dressers, Clinical Clerks, and Assistants to the Pathologist are selected from the Students.

BURSARIES.—The David Foulis Scholarship and the John Reid Prize, value £25 each, are open to Students of the Royal Infirmary.

Fees, which include Hospital Practice and the Clinical Lectures—for one year, £10 10s.; six months, £6 6s.; Three Months, £4 4s. The total fee is £31. Vaccination, £1 1s. Pathology, £4 4s. Bacteriology, £2 2s. For further information apply to

M. THOMAS, M.D., Superintendent.

THE LONDON SCHOOL OF TROPICAL MEDICINE

(UNDER THE AUSPICES OF HER MAJESTY'S GOVERNMENT),
CONNAUGHT ROAD, ALBERT DOCK, E.

IN CONNECTION WITH THE HOSPITALS OF THE SEAMEN'S
HOSPITAL SOCIETY.

The next SESSION commences on TUESDAY, MAY 1, 1900.

For Prospectus, Syllabus, and other particulars, apply to the Secretary, P. MICHELLI, Esq., Seamen's Hospital, Greenwich, S.E.; or to Dr. Rees, the Medical Tutor, at the School.

BARGAINS IN SCIENTIFIC BOOKS.**CAMPBELL (D. H.), THE STRUCTURE**

AND DEVELOPMENT OF THE MOSSES AND FERNS (ARCHEGONIATÆ). By DOUGLAS HOUGHTON CAMPBELL, Ph.D. Fully Illustrated. Medium 8vo. (Pub. 14s. net.) 4s. "Dr. Campbell's book is clearly written, well illustrated, is provided with an accurate bibliography and a copious index, so that it will take its place at once as a standard classic, and will, we think, retain that position for no inconsiderable period."—*Gardener's Chronicle*.

BATESON (W.), MATERIAL FOR THE

STUDY OF VARIATION, treated with especial regard to Discontinuity in the Origin of Species. By WILLIAM BATESON, M.A., Fellow of St. John's College, Cambridge. 8vo, Cloth. (Pub. 21s. net.) 5s.

"The whole work must be carefully read by every serious student; and there can be no question of its great and permanent value as a contribution to our knowledge of a particular class of variations, and as a stimulus to further work in a department of knowledge which is too much neglected."—*Nature*.

HEADLEY (F. W.), THE STRUCTURE

AND LIFE OF BIRDS. By F. W. HEADLEY, M.A., F.Z.S., Assistant Master in Haileybury College. With 78 Illustrations. Crown 8vo, Cloth. (Pub. 7s. 6d.) 1s. 6d.

"We know of no book, at any rate, no modern book, which covers precisely the ground of Mr. Headley's Manual; it strengthens decidedly a weak point in Ornithological literature, and this fact, coupled with the excellence of the illustrations, should ensure for it a wide circulation."—*Ibis*.

COUES (Prof. ELLIOTT), HANDBOOK

OF FIELD AND GENERAL ORNITHOLOGY, a Manual of the Structure and Classification of Birds, with Instructions for Collecting and Preserving Specimens. Illustrated. Demy 8vo, Cloth. (Pub. 10s.) 2s. 6d.

The volume consists of two distinct parts:—PART I.—Field Ornithology contains the necessary Instructions for the Observation and Collection of Birds in the field, and for the Preparation and Preservation of Specimens for scientific study in the Cabinet. PART II.—General Ornithology is a technical Treatise of the Classification, the Zoological Characters, and the Anatomical Structure. CHAPTERS.—Implements for Collecting and their Use—Dogs—Suggestions and Directions for Field-work—Hygiene of Collectorship—Registration and Labelling—Instruments—Materials and Fixtures—How to make a Bird-skin—Collection of Nests and Eggs—Care of a Collection—Definition of Birds—Principles and Practice of Classification—Definitions and Descriptions of the Exterior Parts of Birds—An Introduction to the Anatomy of Birds.

Inland Postage 3d. extra on one, or 6d. on four.
H. J. GLAISHER, New and Remainder Bookseller, 57 Wigmore Street, London, W.

Catalogues Post Free on application.

JAS. SWIFT & SON,

MANUFACTURING OPTICIANS.

SOLELY APPOINTED TO THE A.M. DEPT.
WAR OFFICE, FOR THE SUPPLY
OF MICROSCOPES.

Patent form of Student's Microscope,
fitted with $\frac{2}{3}$ " and $\frac{1}{6}$ " Pan-Aplanatic
Objectives, Iris Diaphragm and Oculars,
in Case, from

£5 5s.

These Instruments we have supplied in
numbers to the following Medical Schools,
viz. St. Mary's, St. Bartholomew's, Guy's,
Middlesex, London, and St. Thomas's.

Seven Gold Medals awarded for excel-
lence of manufacture.

Catalogue on Application.

81 TOTTENHAM COURT ROAD, W.

LETCHER & SONS (formerly Letcher Bros.),

SCIENTIFIC INSTRUMENT MAKERS,

25 TURNPIKE LANE, HORNSEY, N.

BLOWPIPE CABINETS. SPECIALITY: SOCIETY OF ARTS SETS.

PRICE LIST, POST FREE, ON APPLICATION.

For Photography, Unsurpassed for fine definition.

COOKE LENSES

TAYLOR, TAYLOR, & HOBSON,

Stoughton Street Works, Leicester;
and 18 Berners Street, London, W.

ECLIPSE OF THE SUN.**COOK'S SELECT CONDUCTED TOURS**

TO

NAVALMORAL

Including

PARIS, BORDEAUX,

BIARRITZ, MADRID, &c.

Inclusive Fare, £30.

TO

ALGIERS,

By short Sea Route *vid*
DOVER and CALAIS, including

PARIS, MARSEILLES,

ALGIERS, BLIDAH,

GORGE OF CHIFFA, &c.

Inclusive Fare, 29 Guineas.

LEAVING LONDON, MONDAY, MAY 21st.

Including First Class Rail and Steamer Tickets for the Round; First-class Hotel Accommodation; Omnibuses to and from Hotels while with the Conductors; Carriage Excursions; Fees to Hotel and Railway Servants and Admission Fees at all places of interest visited with the Conductors.

PROGRAMMES FREE ON APPLICATION.

INDEPENDENT TICKETS BY ALL ROUTES.

THOS. COOK & SON,

LUDGATE CIRCUS, LONDON,

AND BRANCH OFFICES.

C. E. MÜLLER & CO.,

SCIENTIFIC GLASS BLOWERS,

AND MANUFACTURERS OF

CHEMICAL & PHYSICAL APPARATUS,

X-Ray Tubes, Argon and Helium Spectrum Tubes.

Special Apparatus for Research, Chemical

Thermometers, &c., &c.

**NEW
GEISSLER
TUBES.**

The Flowers ap-
pearing in their
Natural Colours
under the
Kathode Rays.

PRICE £1 : 1 : 0

AN ASSORTMENT KEPT IN STOCK.

PRICE LISTS OF CHEMICAL
APPARATUS ON APPLICATION.

List of **BALANCES** also Post Free.

148 HIGH HOLBORN,
LONDON, W.C.

THE LONDON HOSPITAL MEDICAL COLLEGE.

The SUMMER SESSION commences on May 1.

The Hospital is the largest in the kingdom; nearly 800 beds are in constant use, and no beds are closed. Being the only General Hospital for East London—i.e. for a million and a half people—the practice is immense. In-patients last year, 11,622; Out-patients, 178,838; Accidents, 17,370; Major Operations, 2320.

APPOINTMENTS.—Owing to the enormous number of patients, more Appointments are open to Students than at any other Hospital. Sixty qualified Appointments are made annually, and more than 150 Dressers, Clinical Clerks, &c., appointed every three months. All are free to Students of the College. Holders of Resident Appointments have Free Board.

SCHOLARSHIPS AND PRIZES.—Twenty-seven Scholarships and Prizes are given annually. Students entering in May can compete for five Entrance Scholarships in September.

Special arrangements have been made to enable Students entering in May to present themselves for examination in Chemistry, &c., in July.

SPECIAL CLASSES are held for the University of London and other higher Examinations. Special entries for Medical and Surgical Practice can be made. Qualified Practitioners will find excellent opportunities for studying the rarest diseases.

A reduction of 15 Guineas is made to the Sons of Members of the Profession. ENLARGEMENT OF THE COLLEGE.—The new Laboratories and Class-rooms for Bacteriology, Public Health, Operative Surgery, Chemistry, Biology, &c., have now been added, with all modern improvements.

The Clubs' Union Athletic Ground is within easy reach of the Hospital. The Metropolitan and other Railways have Stations close to the Hospital and College.

For Prospectus and information as to Residence, &c., apply personally, or by letter, to

MUNRO SCOTT, Warden.

Mile End, E.

THE ZOOLOGICAL SOCIETY OF LONDON.

Four Zoological Lectures will be delivered in the Society's Meeting-room, 3 Hanover Square, W., on Thursdays at 4.30 p.m. (after the General Meetings), on April 19, May 17, June 21, and July 19, as follows:—

Date.	Subject.	Lecturer.
Thursday, April 19.	The Animals of Australia.	Mr. A. SMITH WOODWARD, F.Z.S.
" May 17.	The Freshwater Fishes of Africa.	Mr. G. A. BOULENGER, F.R.S., F.Z.S.
" June 21.	The Gigantic Sloths of Patagonia.	Prof. E. RAY LANKESTER, F.R.S., F.Z.S.
" July 19.	Whales.	Mr. F. E. BEDDARD, F.R.S., F.Z.S.

Tickets for these Lectures may be obtained at the Society's Office, price 2s. 6d. each Lecture. Fellows of the Society can obtain Free Tickets for themselves and two friends on application.

SCIENCE AND ART EXAMS.

LONDON AND SOUTH KENSINGTON.

Oral or Correspondence Preparation by SPECIALIST TUTORS.

New and Perfected System of Correspondence Tuition. WORKSHEETS A SPECIALITY, saving Time and Trouble.

ADDRESS:—

JOHN GIBSON, M.A., 24 CHANCERY LANE, W.C.

BLACKBURN MUNICIPAL TECHNICAL SCHOOL.

Applications are invited for the position of SECOND ASSISTANT LECTURER in the Physics and Electrical Engineering Department, for next Session. The duties include part of the Physics teaching in the Day School, and some evening work. Salary, £100 per annum.

Applications should be sent in not later than April 28th, to the undersigned, from whom further particulars may be obtained.

A. W. KING, Secretary.

SCIENCE EXAMINATIONS.

For LONDON and other UNIVERSITIES, the CONJOINT BOARD, &c.

Well-equipped LABORATORIES, DAY AND EVENING. Personal or Class Tuition.

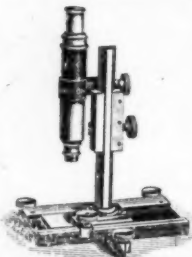
"R," 9 Heathcote Street, Gray's Inn Road, W.C.

Partner Wanted in a Scientific Manufac-

turing Business, with £1000 or upwards. Would suit Scientific Man or Son; exceptional opening; Capital wanted to carry out the Orders open, and—by enlarging Business—to avail of greatly increased trade waiting. Profits very large.—Address, "Scientific," care of NATURE Office.

W. WILSON.

VERNIER MICROSCOPE.



Horizontal and Vertical Scales; 16 cm. in length. The microscope rotates on a horizontal axis, and can be clamped in any position. One power and one Eye-piece.

With Scales reading to .1 mm. £6 10

" " .05 " 7 0

" " .02 " 7 10

" " .01 " 8 5

1 BELMONT STREET, CHALK FARM, N.W.

CARL ZEISS, OPTICAL WORKS, JENA.
ASTRONOMICAL DEPARTMENT.



Binary Apochromatic Telescope Object-Glasses, free from Secondary Spectrum, for Visual purposes. Aperture from 1.17 to 1.20.

Triple Photo-Visual Object-Glasses, free from Secondary Spectrum and Differences in Focus, for Observation and Photography. Aperture 1.10 to 1.15.

Apochromatic Aplanatic Object-Glasses, with reduced Secondary Spectrum, for Astro-Photography.

Achromatic Eye-Pieces, with long Eye-Distance.

Telescope Object-Glasses made of ordinary Silicate Glasses.

Objectives, Prisms, Eye-Pieces, and all Astronomical Accessories.

Complete Mounts for Telescopes in any desired form and size.

Special Astronomical Catalogue, in German, French or English, free on application.

London Branch: 29 Margaret Street, Regent Street, W.



C. BAKER, MICROSCOPE MANUFACTURER.

CATALOGUE 1899-1900

Post Free to readers of this Journal. Apply—

244 HIGH HOLBORN, W.C.

EVERETT & CO.,

Mechanical Engineers and Electricians,
22 CHARTERHOUSE SQUARE, E.C.

MAKERS OF HIGH-GRADE

PHYSICAL & ELECTRICAL APPARATUS.

Apparatus designed and made for Laboratories and Research Work.

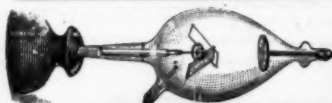
ALL KINDS OF EXPERIMENTAL WORK.

Our List is now ready, and may be had post free on application.

See "Notes" in NATURE, March 15, 1900.



New Design in Galvo. Lamp and Scale.



GLASS BLOWING

GEISSLER TUBES IN BEAUTIFUL DESIGNS.

TUBES containing specimens of Fluorescent and Phosphorescent Minerals, Salts, Rubies, &c.

ILLUSTRATED TUBE contains Vanes which Fluoresce in three brilliant colours, and revolve by means of Cathode Rays.

COSSOR, 87 FARRINGTON ROAD, E.C.

Second Volume.

A SELECTION OF PHOTOGRAPHS OF STARS, STAR CLUSTERS, AND NEBULÆ,

Together with Information concerning the Methods employed in the Pursuit of
Celestial Photography (Illustrated by 72 Photographs reproduced in Collotype),

By ISAAC ROBERTS, D.Sc., F.R.S.

Now Ready. Royal Quarto. Price 30s., post free.

LONDON: KNOWLEDGE OFFICE, 326 HIGH HOLBORN, W.C.

THE GEOGRAPHICAL JOURNAL.

Price 2s. CONTENTS.—APRIL.

A Bathymetrical Survey of the Freshwater Lochs of Scotland. By Sir John Murray, K.C.B., and Fred P. Pullar, Esq., F.R.G.S.
A Fragment of the Geography of England—South-West Sussex. By Hugh Robert Mill, D.Sc., LL.D.
New Light on some Mediæval Maps. By C. Raymond Beazley, M.A.
Moore's Expedition of Tanganyika.
The Ruined Cities of Central America—Review. By Colonel G. E. Church.
Narrative of a Journey to the Lakes Rakas-Tal and Manasarovar, in Western Tibet. By Lieut.-General Sir Richard Strachey, K.E., G.C.S.I.
The Date Live in the Pacific.
The Monthly Record.
Obituary: Admiral Somerset; Dr. Friedrich Jagor.
Correspondence: Fish in Frozen Rivers and Lakes. By Surgeon-Major Geo. Henders n.
Meetings of the Royal Geographical Society, Session 1899-1900.
Geographical Literature of the Month.

Numerous Maps and Illustrations.

EDWARD STANFORD. 26-27 Cockspur Street, Charing Cross, S.W.

Now Ready. 8vo. Price 4s. net.

INORGANIC EVOLUTION

AS STUDIED BY
SPECTRUM ANALYSIS.

BY

SIR NORMAN LOCKYER, K.C.B., F.R.S.

MACMILLAN AND CO., LTD., LONDON.

On the OCCURRENCE of CYANOGEN
COMPOUNDS in COAL-GAS, and of the SPECTRUM of CYANOGEN in that of the Oxy-Coal-Gas Flame.

By W. N. HARTLEY, F.R.S.,

Royal College of Science, Dublin.

Being the Scientific Proceedings of the Royal Dublin Society, Vol. IX. N.S. Part 3, No. 19. Price Sixpence.

WILLIAMS & NORGATE, 14 Henrietta Street, W.C.

NOW READY.

Tenth Edition. Illustrated with numerous Plates and Diagrams.
Pp. 502. Cr. 8vo. Cloth, 6s. net.

INSTRUCTION IN PHOTOGRAPHY.

BY

Sir W. de W. ABNEY, K.C.B., D.C.L., F.R.S.

Revised and greatly enlarged, bringing the book up to date, and including additional chapters on Photo-block Work, Three-colour Work, Hand Camera and Film Photography, Paper Processes, New Developers, &c., &c.

London: SAMPSON LOW, MARSTON & COMPANY, Limited,
St. Dunstan's House, Fetter Lane, Fleet Street, E.C.

NATURE PRINTING IN COLOURS.

LEPIDOPTERA.

The Colours, Tints, and Shades of the Wings are true to Nature and as perfect as if Photographed in Colours (were this possible). They are done by a secret process, and scarcely distinguishable from the real insect.
1 Specimen, 1s. 6d.; 1 doz., 8s.; 1 doz., 15s.; remittance with order.—
BERNARD PIFFARD, Hemel Hempstead, Herts.

Sale by Auction.

MONDAY, APRIL 23.

THE REMAINING PORTION OF THE "SAMUEL STEVENS" COLLECTION.

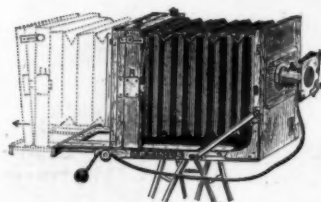
MR. J. C. STEVENS will Sell by Auction, at his Great Rooms, 38 King Street, Covent Garden, on Monday, April 23, the remaining portion of the well-known Collection of British Lepidoptera formed by the late SAMUEL STEVENS, Esq., F.R.S., F.L.S., comprising the Micro-Lepidoptera, the Supplementary Series of Macros and the Duplicates, together with the Cabinets, Books, &c., appertaining to the Collection.

On View Saturday prior, from 10 till 4, and Morning of Sale. Catalogues on application, post free.

TRADE
MARK

"OPTIMUS."

TELEGRAPHIC
ADDRESS.



PHOTOGRAPHIC APPARATUS

OF BEST WORKMANSHIP
FOR ALL PURPOSES.

Catalogue POST FREE.



PERKEN, SON & CO., LTD., 99, HATTON GARDEN, HOLBORN CIRCUS, E.C. LONDON.

A. AND C. BLACK'S LIST.

A TREATISE ON ZOOLOGY.

By E. RAY LANKESTER, M.A., LL.D., F.R.S., Hon. Fellow of Exeter College, Oxford; Director of the Natural History Departments of the British Museum; Fullerian Professor of Physiology and Comparative Anatomy in the Royal Institution of London. Profusely Illustrated. To be completed in Ten Parts. NOW READY. Part III. THE ECHINODERMA. By F. A. BATHER, M.A., assisted by J. W. GREGORY, D.Sc., and E. S. GOODRICH, M.A. Demy 8vo, paper covers, price 12s. 6d net; cloth, price 15s. net.

"It is marked by three characteristics, which indeed may be regarded as now indispensable to any scientific work of value—perfect lucidity in the illustrations, which are numerous, and, of course, specially drawn by, or under the direction of, the author; a careful exposition of the historical development of life-forms; and complete biographies on each branch of the subject."—*Literature*.

NOW READY. Demy 8vo, cloth, price 12s. 6d. net.

SEXUAL DIMORPHISM IN THE ANIMAL KINGDOM.

A Theory of the Evolution of Secondary Sexual Characters. By J. T. CUNNINGHAM, M.A. Containing 32 Illustrations.

"Mr. Cunningham has elaborated a theory of evolution in answer to the problem: What are the causes which have produced the three kinds of structural difference in animals? He supports his theory by facts and illustrations drawn mainly from the works of others. A book of distinct scientific importance. The present volume is well printed and profusely illustrated with carefully executed figures."—*The Outlook*.

NOW READY. Crown 8vo, cloth, price 3s. 6d.

INTRODUCTION TO STRUCTURAL BOTANY.

Part II. Flowerless Plants. Third Edition. By D. H. SCOTT, M.A., Ph.D., F.R.S., Honorary Keeper of the Jodrell Laboratory, Royal Gardens, Kew.

"It stands out from the ever-increasing crowd of guides, text-books, and manuals, in virtue not only of originality of design, but also of the fact that the subjects treated have been specially investigated for the purpose of the book, so that we have not the mere compilation of a book-man, but an account based on the results of the author's own observation."—*Natural Science*.

NOW READY. Post 8vo, cloth, price 12s. 6d.

ALGEBRA. An Elementary Text-book for the Higher Classes of Secondary Schools and Colleges. Part II. Second Edition. By Prof. GEORGE CHRYSAL, M.A., LL.D.

"The merits of the work are so well known that it is unnecessary to do more than announce the publication of the new edition."—*Nature*.

NOW READY. Demy 8vo, cloth, price 7s. 6d. net.

THE GRAMMAR OF SCIENCE.

By KARL PEARSON, M.A., F.R.S., Professor of Applied Mathematics and Mechanics in University College, London. Second Edition, thoroughly Revised and much Enlarged. Contains Two entirely New Chapters on Natural Selection and Heredity, embracing a Popular Account of Prof. Pearson's own more recent work in this direction. Containing 33 Illustrations in the Text.

"It is still a grammar in that it deals with the foundations of science; but a far more ambitious title might have been given to so comprehensive a work."—*The Bookman*.

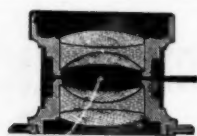
NOW READY. Demy 8vo, cloth, price 10s. 6d.

TEMPERATE CHILE: a PROGRESSIVE SPAIN.

By W. ANDERSON SMITH, formerly Special Commissioner to the Chilean Government to Report on their Rivers.

"The book is both charming and valuable."—*Nature*.

A. AND C. BLACK, SOHO SQUARE, LONDON.



ROSS, Ltd.,

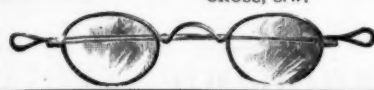
Manufacturers of Celebrated
ROSS' PORTRAIT AND VIEW LENSES
ROSS-ZEISS' ANASTIGMATIC LENSES
ROSS-GOERZ' DOUBLE ANASTIGMATS
ROSS' NEW HAND-CAMERA LENSES
ROSS' FIELD AND STUDIO CAMERAS
ROSS' SPECIAL HAND CAMERAS
ROSS' NEW ENLARGING LANTERNS
ROSS' PATENT SCIENCE LANTERNS
ROSS' NEW ECLIPSE MICROSCOPES
ROSS' IMPROVED TELESCOPES
ROSS' FIELD AND OPERA GLASSES
ROSS' NEW PRISMATIC BINOCULARS
&c., &c., &c.



ROSS, Ltd.,

(ESTAB. 1830.)

MANUFACTURING OPTICIANS,
111 NEW BOND ST., LONDON, W.,
AND
31 COCKSPUR ST., CHARING
CROSS, S.W.



IMPROVED D'ARSONVAL GALVANOMETERS.

PRICES

£10-0-0

AND

£4-10-0

LIBERAL DISCOUNTS.

Most
SENSITIVE
for
DEFLECTIVE,
ZERO,
or
BALLISTIC
WORK.



Write for Price List and Particulars of Potentiometers, Galvanometers, Electrical Thermometers, Experimental Direct and Alternating Current Sets, &c., to

CROMPTON & CO., LD.,

Laboratory { "THRIPLANDS," } LONDON, W.
KENSINGTON COURT,

GRIFFIN'S METALLURGICAL SERIES.

Edited by Sir W. C. ROBERTS-AUSTEN.

NOW READY. Illustrated, Cloth, Price 16s.

SILVER,

BEING PART II. OF

THE METALLURGY OF LEAD AND SILVER.

BY

H. F. COLLINS, A.R.S.M.

Complete in itself, and sold separately.

CONTENTS:—

Properties of Silver and its Principal Compounds.—Silver Ores.—The Patio Process.—The Kayo, Fondon, Kröhne and Tina Processes.—The Pan Process.—Roast Amalgamation.—Treatment of Tailings and Concentrates.—Retorting, Melting, and Assaying.—Chloridising—Roasting.—The Augustin, Claudet, and Zivovogel Processes.—The Hypsulphite Leaching Process.—Refining.—Matte Smelting in Blast Furnaces.—Pyritic Smelting.—Matte Smelting in Reverberatories.—Silver-Copper Smelting and Refining.—INDEX.

Already Issued, uniform with above, Price 16s.

Part I., **LEAD.** A Treatise on the Manufacture of Lead, and on Smelting, Desilverisation, Assay, and Analysis.

NOW READY. With Frontispiece, Plans, and Illustrations, Price 6s.

THE

CYANIDE PROCESS OF GOLD EXTRACTION.

A TEXT-BOOK FOR THE USE OF MINING STUDENTS, METALLURGISTS, AND CYANIDE OPERATORS.

BY

JAMES PARK, F.G.S., M.Inst.M.M.,

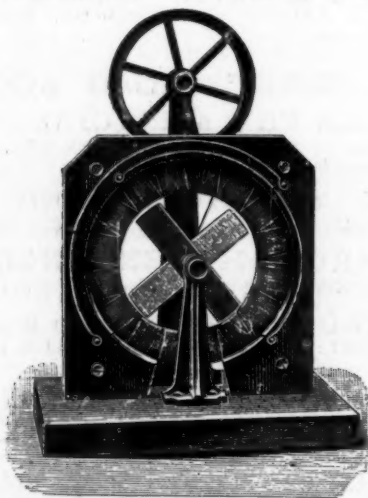
Late Director, Thames School of Mines, and Geological Surveyor and Mining Geologist to the Government of New Zealand.

First English Edition, thoroughly Revised and greatly Enlarged from the Third Edition (published in New Zealand). With additional details concerning the Siemens-Halske, and other recent Processes of Extraction.

LONDON: CHARLES GRIFFIN & Co., LTD.,
EXETER STREET, STRAND.

E. LEYBOLD'S NACHFOLGER,SCIENTIFIC INSTRUMENT
MAKERS,

COLOGNE (GERMANY).



New Catalogue of Physical Apparatus,
containing 3400 numbers and 1200 illustrations,
sent on application.

**DUDELL
OSCILLOGRAPH.**

An Invaluable Instrument for
Alternate Current Work.

This Galvanometer has the shortest
periodic time of any Instrument
yet constructed, viz. 0.0001 Second,
is perfectly dead-beat, and the self-
induction is practically nil.

WRITE FOR DESCRIPTIVE PAMPHLET.

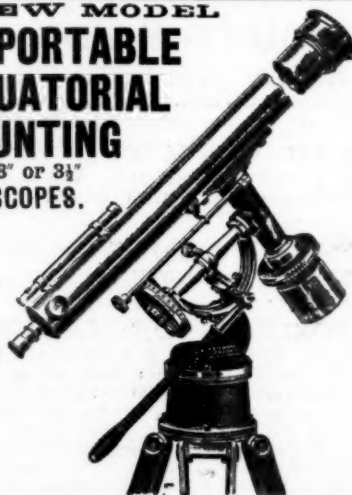
SOLE MAKERS—

SCIENTIFIC INSTRUMENT CO.

LIMITED,

CAMBRIDGE.

**NEW MODEL
PORTABLE
EQUATORIAL
MOUNTING**
For 3" or 3½"
TELESCOPES.



Latitude Adjustment, Clamp for Declination Axis, Quick and Slow Motion, in Right Ascension.

EQUATORIAL MOUNTING with Divided Circles and Stand fitted with short Iron Column, Levelling Screws, and Metal Stretcher, £15 15s.; or, complete with 3" Telescope, £25.

ILLUSTRATED CATALOGUE GRATIS.

J. H. STEWARD,
OPTICIAN.

406 STRAND, 457 WEST STRAND,
7 GRACECHURCH STREET, LONDON.

MACMILLAN & CO.'S BOOKS FOR THE SPRING.

THE GARDEN.

21ST THOUSAND.

ELIZABETH and her GERMAN GARDEN. Extra crown 8vo, 6s.

11TH THOUSAND.

THE SOLITARY SUMMER.

By the same Author. Extra crown 8vo, 6s.

THE BOOK OF THE ROSE.

By Rev. A. FOSTER-MELLIAR, M.A. Illustrated. Extra crown 8vo, 8s. 6d. net.

GARDEN MAKING. Suggestions

for the Utilisation of Home Grounds. By L. H. BAILEY. Globe 8vo, 4s. net.

GARDEN FLOWERS AND

PLANTS. A Primer for Amateurs. By J. WRIGHT, F.R.H.S. With 50 Illustrations. Pott 8vo, 1s.

A YEAR IN A LANCASHIRE

GARDEN. By HENRY A. BRIGHT. Crown 8vo, 3s. 6d.

THE ENGLISH FLOWER

GARDEN. By HENRY A. BRIGHT. With illustrative notes. Crown 8vo, 3s. 6d.

THE COUNTRY-SIDE.

TALES OF THE BIRDS. By

W. WARDE FOWLER, M.A. Illustrated. Crown 8vo, 3s. 6d.

A YEAR WITH THE BIRDS.

By W. WARDE FOWLER, M.A. With Illustrations by BRYAN HOOK. Third Edition. Enlarged. Crown 8vo, 3s. 6d.

SUMMER STUDIES OF BIRDS

AND BOOKS. By W. WARDE FOWLER, M.A. Crown 8vo, 6s.

CURIOSITIES OF NATURAL

HISTORY. By FRANCIS T. BUCKLAND. Popular Edition, with a few Illustrations. Each series separately, in small 8vo, price 2s. 6d. as follows: FIRST SERIES—Rats, Serpents, Fishes, Frogs, Monkeys, &c. SECOND SERIES—Fossils, Bears, Wolves, Cats, Eagles, Hedgehogs, Eels, Herrings, Whales. THIRD SERIES—Wild Ducks, Fishing, Lions, Tigers, Foxes, Porpoises. FOURTH SERIES—Giants, Mummies, Mermaids, Wonderful People, Salmon, &c.

ROUND THE YEAR. A Series

of Short Nature Studies. By Prof. L. C. MIALL, F.R.S. With Illustrations, chiefly by A. R. HAMMOND, F.L.S. Crown 8vo, 5s.

MADAME HOW AND LADY

WHY; or First Lessons in Earth-lore for Children. By CHARLES KINGSLEY. Crown 8vo, 3s. 6d.

THE COUNTRY-SIDE—(continued.)

AMONG ENGLISH HEDGE-ROWS. Written and Illustrated by CLIFTON JOHNSON. Extra Crown 8vo, gilt top, 8s. 6d. net.

NATURAL HISTORY AND

ANTIQUITIES OF SELBORNE. By GILBERT WHITE, with Notes by FRANK BUCKLAND, a Chapter on Antiquities by Lord SELBORNE, and new Letters. Illustrated. Crown 8vo, 6s.

FORTY YEARS IN A MOOR-

LAND PARISH. Reminiscences and Researches in Danby-in-Cleveland. By the late CANON ATKINSON, D.C.L. With Maps and Illustrations. Extra crown 8vo, 5s. net. Illustrated Edition, 12s. net.

HIGHWAYS & BYWAYS.

NORMANDY. By PERCY

DEARMER, M.A. Illustrated by JOSEPH PENNELL. Extra crown 8vo, 6s. [Just ready.]

DONEGAL, &c. By STEPHEN

GWYNN. Illustrated by HUGH THOMSON. Extra crown 8vo, 6s.

YORKSHIRE. By ARTHUR H.

NORWAY. Illustrated by JOSEPH PENNELL and HUGH THOMSON. Extra crown 8vo, 6s.

NORTH WALES. By A. G.

BRADLEY. Illustrated by HUGH THOMSON and JOSEPH PENNELL. Extra crown 8vo, 6s.

DEVON AND CORNWALL.

By A. H. NORWAY. Illustrated by JOSEPH PENNELL and HUGH THOMSON. Extra crown 8vo, 6s.

MR. HISSEY'S ROAD BOOKS.

OVER FEN and WOLD. With

Fourteen Full-page (and some smaller) Illustrations. Demy 8vo, 16s.

ON SOUTHERN ENGLISH

ROADS. With Illustrations. Demy 8vo, 16s.

THROUGH TEN ENGLISH

COUNTIES. With Illustrations. Demy 8vo, 16s.

ACROSS ENGLAND in a DOG-

CART: from London to St. David's and Back. With Illustrations. Demy 8vo, 16s.

AN OLD-FASHIONED

JOURNEY IN ENGLAND AND WALES. Demy 8vo, with Frontispiece, 12s.

A HOLIDAY ON THE ROAD.

An Artist's Wanderings in Kent, Sussex, and Surrey. With Illustrations. Demy 8vo, 16s.

MACMILLAN AND CO., LIMITED, LONDON.

MACMILLAN & CO.'S NEW SCIENTIFIC BOOKS.

MICRO-ORGANISMS AND FERMENTATION.

By ALFRED JÖRGENSEN,

Director of the Laboratory for the Physiology and Technology of Fermentation at Copenhagen. Translated by ALEX. K. MILLER, Ph.D., F.I.C., and A. E. LENNHOLM. Third Edition, completely Revised. With 83 Illustrations. 8vo. 10s. net.

AN ELEMENTARY COURSE OF PRACTICAL ZOOLOGY.

By the late T. JEFFERY PARKER, D.Sc., F.R.S., Professor of Biology in the University of Otago, Dunedin, New Zealand, and W. NEWTON PARKER, Ph.D., Professor of Zoology at the University College of South Wales and Monmouthshire, in the University of Wales. With 156 Illustrations. Crown 8vo. 10s. 6d.

LANCET.—"Will be found serviceable to the upper classes of schools where natural history is taught, and to classes for elementary biology in medical schools."

A MANUAL OF ZOOLOGY.

By the late Prof. T. J. PARKER, D.Sc., F.R.S., and Prof. W. A. HASWELL, M.A., D.Sc., F.R.S. With Three Hundred Illustrations. Crown 8vo, 10s. 6d.

ZOOLOGIST.—"The present publication may be considered a condensation of the previous work ('A Text-Book of Zoology'). . . . Thus we have the essence of a really good book in a convenient form for teachers and students."

KNOWLEDGE.—"The text is accompanied by about three hundred beautiful illustrations. . . . The treatment is explicit throughout, and the book is sure to gain a wide popularity."

ENLARGED AND REVISED EDITION NOW READY.

LESSONS IN ELEMENTARY PHYSIOLOGY.

BY THOMAS H. HUXLEY, LL.D., F.R.S.

Enlarged and Revised Edition. Globe 8vo. 4s. 6d.

TEXT-BOOK OF PALÆONTOLOGY.

By KARL A. VON ZITTEL,

Professor of Geology and Palæontology in the University of Munich. Translated and Edited by CHAS. R. EASTMAN, Ph.D., Assistant in Palæontology in the Museum of Comparative Zoology at Harvard. With 1476 Woodcuts. Medium 8vo. 25s. net.

*. * This English Edition is revised and enlarged by the Author and Editor in collaboration with numerous Specialists.

SPEAKER.—"A most valuable addition to the scientific literature of the world, and the publication of the second volume, dealing with the Vertebrata, will be awaited with the keenest interest on all sides."

THE PRINCIPLES OF MECHANICS PRESENTED IN A NEW FORM.

By HEINRICH HERTZ, late Professor of Physics in the University of Bonn. With an Introduction by H. VON HELMHOLTZ. Authorised English Translation by D. E. JONES, B.Sc., District Inspector under the Department of Science and Art, &c., and J. T. WALLEY, M.A. 8vo. 10s. net.

ENGINEER.—"A very remarkable book. . . . A book which it is impossible to pass over in silence, fraught as it is with infinite possibilities of the future. It represents the latest work of one of the finest intellects of the century."

INTRODUCTION TO PHYSICAL CHEMISTRY. By JAMES WALKER, D.Sc.,

Ph.D., Professor of Chemistry in University College, Dundee. 8vo. 10s. net.

LANCET.—"The book is written in such a lucid way as to render its perusal free from that irksomeness which is so often the student's experience when confronted with theoretical considerations. The book should serve as an admirable introduction to more advanced works."

NOW COMPLETE IN THREE VOLS.

DICTIONARY OF POLITICAL ECONOMY. Edited by R. H. INGLIS PALGRAVE.

Medium 8vo. 21s. net each.

ECONOMIC JOURNAL.—"The list of contributors is a brilliant one. They have played their parts well, and the editor has managed them with great ability. . . . If its success is at all commensurate with its deserts, the publishers may congratulate themselves upon a very valuable venture. No working economist can afford to be without this dictionary. Mr. Palgrave's dictionary emerges successfully from the severe test of comparison with its French and German predecessors."

A DIVIDEND TO LABOUR. A Study of Employers' Welfare Institutions. By

NICHOLAS P. GILMAN. Crown 8vo. 7s. 6d.

MAN AND HIS ANCESTOR. A Study in Evolution. By CHARLES MORRIS.

Globe 8vo. 5s.

THE FARMSTEAD. The Making of the Rural Home and the Lay-out of the

Farm. By Prof. I. P. ROBERTS. Illustrated. Globe 8vo. 4s. 6d. net.

[The Rural Sciences Series.]

MACMILLAN AND CO., LIMITED, LONDON.

ALBERT EDWARD JAMRACH(Late CHARLES JAMRACH),
NATURALIST,

180 ST. GEORGE STREET EAST.

Implements of Savage Warfare, Idols, Sacred Masks, Peruvian Pottery,
Netsukis China, Lacquers, Gongs, Shells, and other Curios.

THE MOST NUTRITIOUS.

E P P S'S

GRATEFUL—COMFORTING.

C O C O A

BREAKFAST—SUPPER.

HOLLOWAY'S PILLS

CURE

Billousness, Sick Headache, Indigestion, and
all Internal Complaints.

CAN BE TAKEN BY THE MOST DELICATE.

Holloway's Pills and Ointment may be obtained of
all Medicine Vendors.**WORKS BY SIR ARCHIBALD GEIKIE, F.R.S.****ELEMENTARY LESSONS**
IN PHYSICAL GEOGRAPHY. Illustrated with Wood-
cuts and Ten Plates. Foolsap 8vo. 4s. 6d. Questions
on same, 1s. 6d.**PHYSICAL GEOGRAPHY.** With
Illustrations. Pott 8vo. 1s. [*Science Primers.*]**THE SCENERY AND GEOLOGY**
OF SCOTLAND, VIEWED IN CONNEXION WITH
ITS PHYSICAL GEOLOGY. Illustrated. Crown 8vo.
12s. 6d.**GEOLOGICAL SKETCHES AT**
HOME AND ABROAD. 8vo. 10s. 6d.**TYPES OF SCENERY AND THEIR**
INFLUENCE ON LITERATURE. 8vo. Sewed. 2s. net.**MEMOIR OF SIR A. C. RAMSAY.**
8vo. 12s. 6d. net.

MACMILLAN AND CO., LIMITED, LONDON.

SCIENTIFIC WORTHIES.

The following is a list of the Steel Portraits that have appeared in the above Series:—

MICHAEL FARADAY.

THOMAS HENRY HUXLEY.

CHARLES DARWIN.

JOHN TYNDALL.

SIR GEORGE GABRIEL STOKES.

SIR CHARLES LYELL.

SIR CHARLES WHEATSTONE.

SIR WYVILLE THOMSON.

ROBERT WILHELM BUNSEN.

LORD KELVIN.

BARON ADOLF ERIK NOR-

DENSKJÖLD.

HERMANN L. F. HELMHOLTZ.

SIR JOSEPH DALTON HOOKER.

WILLIAM HARVEY.

SIR GEORGE B. AIRY.

J. LOUIS R. AGASSIZ.

JEAN BAPTISTE ANDRÉ DUMAS.

SIR RICHARD OWEN.

JAMES CLERK MAXWELL.

JAMES PRESCOTT JOULE.

WILLIAM SPOTTISWOODE.

ARTHUR CAYLEY.

SIR C. W. SIEMENS.

JOHN COUCH ADAMS.

JAMES JOSEPH SYLVESTER.

DMITRI IVANOWITSH MEN-

DELEEF.

LOUIS PASTEUR.

SIR ARCHIBALD GEIKIE.

LORD LISTER.

STANISLAO CANNIZZARO.

PROF. VON KÖLLIKER.

PROF. SIMON NEWCOMB.

N.B.—The Portraits of Sir A. Geikie, Lord Lister, Prof. Cannizzaro, Prof. von Kölliker, and
Prof. S. Newcomb belong to a New Series and are Photographures.Proof impressions of these, printed on India paper, may be had from the Publishers, price 5s. each; or the Series
of 32 Portraits in a Handsome Portfolio for £8 5s., carriage paid. The Portfolio may be had separately, price 6s.Cheques and Money Orders payable to **MACMILLAN & CO., Limited.**

OFFICE OF "NATURE," ST. MARTIN'S STREET, LONDON, W.C.

WATKINS & DONCASTER,

NATURALISTS,

AND MANUFACTURERS OF

CABINETS AND APPARATUSFOR ENTOMOLOGY, BIRDS' EGGS, AND ALL BRANCHES OF
NATURAL HISTORY.**SPECIAL SHOW-ROOM FOR CABINETS.**Call or send for detailed Catalogue (86 pp.), Post free on
application.**N.B.**—For Excellence and Superiority of Cabinets and
Apparatus, references are permitted to distinguished
patrons, Museums, Colleges, &c.**A LARGE STOCK OF INSECTS AND BIRDS' EGGS.**Birds, Mammals, &c., Preserved and Mounted by First-class Workmen
with true natural surroundings. All Books and Publications on Natural
History supplied.**36 STRAND, LONDON, W.C.**

(Five Doors from Charing Cross.)

TO SCIENCE LECTURERS.**HUGHES' MOTO-PHOTOSCOPE FOR LIVING PICTURES.**

THE MOST PERFECT.

No SHUTTER, therefore no Flickering. Superb Mechanism.

The Moto-Photo Camera for taking the Pictures. Illustrations, Lists, &c.
See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN,
&c. Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great
success. New Oxyhydrogen Microscope. Science Lanterns for Class
Demonstration. Magnificent Results. Docwra Triple, Prize Medals
Highest Award. Supplied to the Royal Polytechnic Institution, Dr. H. GRAT-
TAN GUINNESS, Madame ADELINA PATTI, &c., &c. Patent Pamphengio,
Science Lanterns. The Universal Lantern 4-inch Condensers. 4-wick Lamp,
Portrait Combination front Lenses, 12s. 6d., Marvellous value. Science
Lecture Sets. Novelties. The Lantern Kaleidoscope. Cheapest Lantern
Outfits in the World. Grandly Illustrated Catalogue, over 180 choice En-
gravings, 6d.; Postage, 3d. List of 300 Lecture Sets, Science Subjects,
Views, &c., 6d.; Postage 2d. Pamphlets Free. **W. C. HUGHES,**
SPECIALIST, Brewster House, 28 Mortimer Road, Kingsland, N.**TEXT-BOOK OF GEOLOGY.** With
Illustrations. Third Edition. Revised and Enlarged.
Medium 8vo. 28s.**CLASS-BOOK OF GEOLOGY.** Illus-
trated with Woodcuts. Second Edition. Crown 8vo. 4s. 6d.**OUTLINES OF FIELD GEOLOGY.**
New and Revised Edition. Extra fcap. 8vo. 3s. 6d.**GEOLOGY.** With Illustrations. Pott
8vo. 1s. [*Science Primers.*]**BOX OF GEOLOGICAL SPECIMENS TO ILLUSTRATE GEIKIE'S**
PRIMER OF GEOLOGY, 10s. 6d.**ANCIENT VOLCANOES OF GREAT**
BRITAIN. 2 vols. Royal 8vo. 36s. net.**THE FOUNDERS OF GEOLOGY.**
Extra crown 8vo. 6s. net.

ESTABLISHED 1851.

(Represented by Messrs. HARRINGTON BROS., Oliver's Yard,
53A City Road, London, E.C. : and Cork, Ireland.)

*The first line being in heavy type is charged for as Two Lines.

The... 'N. & G.' Cameras

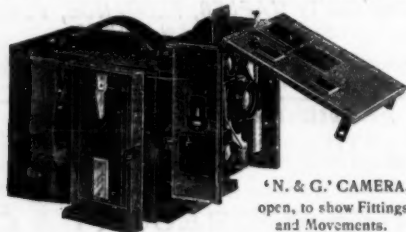
In all sizes up to 7 x 5 in.
For Plates, Cut Films, or Film
in Spools.

For Hand and Tripod.

A Series of High-Class Instruments for Serious Work,
embodying every New Advance in Photography.

Prices from £13 to £50.

Have been in Constant Use for Eight Years in all parts of the World.



'N. & G.' CAMERA,
open, to show Fittings
and Movements.

TRIPOD CAMERAS, SURVEYING CAMERAS, and very Small and
Light POCKET CAMERAS for Travellers and Field Naturalists.

Speciality: COMPLETE OUTFITS for Scientific Expedi-
tions and Special Research.

Catalogues and Estimates free on application. Lenses, Kinematographs, Lanterns, and all
Photographic Accessories and Materials.

Newman & Guardia, Ltd.

90 & 92 Shaftesbury Avenue, London, W.

TOWNSON & MERCER.

(ESTABLISHED 1798.)

Retail—89 BISHOPSGATE STREET WITHIN, E.C.

Wholesale—34 CAMOMILE STREET, E.C.

Scientific Apparatus Manufacturers and Laboratory
Outfitters to the Home and Colonies Departments of
H.M. Government; Institutions, Colleges, and the
various Industries throughout the World.

Complete Illustrated Catalogue of over 6 pages, with about
3000 illustrations. 3s. (Free to Colleges and Schools.)



PYROMETER. Sensitive Adjust-
ment giving wide readings on bold
Scale. Suitable for Lecture Demon-
stration. With Rods of Copper, Iron,
and Brass (interchangeable) for com-
paring degree of expansion. Mounted
on Polished Wood base, complete with
Spirit Burners, £1

Pulley, very smooth running, almost
frictionless, Aluminium, in Brass Frame,
Steel Bearings and Adjusting Screws.
With Clamp to fix to Blackboard for
demonstrating Parallelogram of Forces
and many other experiments in Me-
chanics. Price 3s. 6d.



WIRELESS
TELEGRAPHY.
X RAYS.
BACTERIOLOGICAL
RESEARCH.
MECHANICS.
PNEUMATICS.
HYDROSTATICS.
HYDRAULICS.
SOUND, LIGHT, &
HEAT.
MAGNETISM AND
ELECTRICITY.

OPPOSITE THE BRITISH MUSEUM.

THACKERAY HOTEL

(TEMPERANCE).

GREAT RUSSELL STREET, LONDON.

THIS newly-erected and commodious Hotel will, it is believed, meet the requirements of those who desire all the conveniences
and advantages of the larger modern licensed hotels at moderate charges. Passenger Lift. Electric Light in all Rooms. Bath-rooms
on every Floor. Spacious Dining, Drawing, Writing, Reading, and Smoking Rooms. All Floors Fireproof. Perfect Sanitation.
Night Porter. Telephone. Bedrooms from 2s. 6d. to 4s. 6d. per night. Full Tariff and Testimonials on application.

Telegraphic Address: "THACKERAY, LONDON."

Proprietor—J. TRUSLOVE.

Also, amalgamated with, and under the same management,

ESMOND HOTEL

(TEMPERANCE).

MONTAGUE STREET, RUSSELL SQUARE.

THIS Hotel, which has been carried on so successfully for the last 13 years, adjoins the British Museum, and is exception-
ally quiet. Bedrooms from 2s. to 3s. 6d. per night. Full Tariff and Testimonials on application.

Telegraphic Address: "TRUSLOVE, LONDON."

Proprietor—J. TRUSLOVE.

TO SCIENTIFIC MEN, NATURALISTS, TRAVELLERS, AND OTHERS.

THE STEREOSCOPIC COMPANY

CAN SPECIALLY
RECOMMEND ANY OF
THE FOLLOWING
HAND CAMERAS



ADDRESS—

106 & 108 REGENT ST., W.,
and 54 Chancery Lane, E.C.

THE TWIN-LENS ARTIST,

with full size Focussing
Finder, Rapid Euryscope
Lenses, Time and Instanta-
neous Shutter, Rising Front,
Focussing Adjustment,
Double Dark Slides,
Magazine or Cartridge
Roll Holders.

1/2-p. complete, with 3 Slides ... 14 14

5 x 4 complete, with 3 Slides ... 16 16

1/2-p. complete, with 3 Slides ... 21 0

THE TWIN-LENS ARTIST,

with
MAGAZINE
for 12 Plates or
24 Films,
&c., &c.,
as described.

1/2-p. complete... 15 15

5 x 4 " ... 17 17

1/2-p. " ... 22 3

THE TWIN-LENS CARLTON,

Carrying 12 Plates
or Films,
and now so well known
as not to
need description.

PRICE:

1/2-p. complete... 12 12

5 x 4 " ... 15 15

1/2-p. " ... 21 0

PLEASE READ

Extract of Letter from
R. BOWDLER SHARPE,
Esq., LL.D.,
Assist. Keeper Zoological
Dept., British Museum,
March 4, 1898:—

"I consider it one of the
best day's work I ever did
when I bought one of your
Cameras. The ease with
which it is worked, and the
excellent results obtained,
make it a most pleasurable
accompaniment of a summer's
outing."

FREE LESSONS TO
PURCHASERS.



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 1590, VOL. 61]

THURSDAY, APRIL 19, 1900.

[PRICE SIXPENCE.

Registered as a Newspaper at the General Post Office.]

[All Rights are Reserved.

WIRELESS TELEGRAPHY.

The "APPS-NEWTON" INDUCTION COILS have proved far superior to all others in telegraphing long distances without wires.

They were used in the Government Experiments at Penarth and Dover; also by Signor Marconi and the Wireless Telegraph Company in telegraphing to and from the Goodwin Lightship, and across the Channel; at the British Association Meeting at Dover for telegraphing to France; and at the Naval Manœuvres, where a distance of sixty miles was covered, &c.

After prolonged tests the "Apps-Newton" Coils have been adopted by the Wireless Telegraph Company, by the War Office and by the Admiralty; several have been sent to the Front in South Africa, and the ships of the Channel Squadron are now being fitted with them.

PRICES ON APPLICATION.

SOLE MAKERS:

NEWTON & CO.,

Scientific Instrument Makers to H.M. the Queen
and the Government,

3 FLEET STREET, LONDON, E.C.

BECK'S

NEW OIL IMMERSION

1/10 OBJECT GLASS 1 NA.

PRICE £3 : 0 : 0.

BECK'S OTHER OIL IMMERSION OBJECT GLASSES.

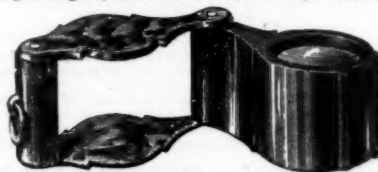
1/12 in 1 NA.	...	...	...	£4	0	0
1/12 in 1'25 NA.	...	...	...	5	10	0
1/12 in 1'4 NA.	...	...	...	8	0	0
1/16 in 1'25 NA.	...	...	...	9	0	0

COMPLETE CATALOGUE ON APPLICATION.

R. & J. BECK, Ltd.,
68 CORNHILL, E.C.

BROWNING'S PLATYSCOPIC LENS.

With Larger Angles, Increased Field, and Improved Definition.



Engraved Real Size.

AN ACHROMATIC COMBINATION,

COMBINING THE DEFINITION OF A MICROSCOPE WITH THE
PORTABILITY OF A POCKET LENS.

"If you carry a small Platyscopic Pocket Lens (which every observer of Nature ought to do)."—GRANT ALLEN in *Knowledge*.

The Platyscopic Lens is invaluable to botanists, mineralogists, or entomologists, as it focuses about three times as far from the object as the Coddington Lenses. This allows opaque objects to be examined easily.

The Platyscopic Lens is made of four degrees of power, magnifying respectively 10, 15, 20, and 30 diams.; the lowest power, having the largest field, is the best adapted for general use.

The Lenses are set in Ebonite Cells, and mounted in Tortoiseshell Frames.

Price of the Platyscopic Lens, mounted in Tortoiseshell, magnifying either 10, 15, 20, or 30 diameters, each power, 15s.

In nickelised German Silver, each power, 17s. 6d.

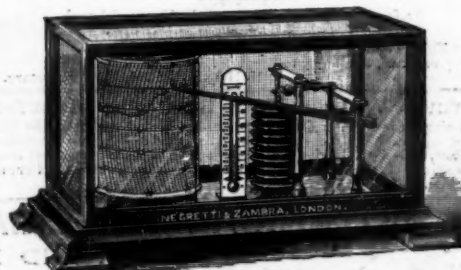
Illustrated Description sent free.

JOHN BROWNING, 63 STRAND, LONDON, W.C.

NEGRETTI & ZAMBRA'S Self-Registering

Barometers, Thermometers and Rain Gauges.

Giving continuous Records on Charts, and only requiring attention
once a week.



THE LARGE SIZE BAROGRAPH. £7 10 0

Accurate Thermometers for all purposes.

Illustrated Price List of Instruments free by post to all
parts of the World.

38 HOLBORN VIADUCT, E.C.

BRANCHES—45 CORNHILL, and 122 REGENT STREET.

ST. MARY'S HOSPITAL MEDICAL SCHOOL, PADDINGTON, W.

The SUMMER SESSION will BEGIN on May 1st. The Hospital is in close proximity to Paddington Station, Great Western Railway, to the terminus of the Great Central Railway, and to several stations of the Metropolitan and District Railways. The School provides complete preparation for the Higher Examinations and Degrees of the Universities. The Hospital affords great facilities for all branches of clinical study. The numerous clinical appointments in the Hospital are free to all students, and the resident medical appointments are awarded by competitive examination.

The NEW OUT-PATIENTS' DEPARTMENT in the Clarence Memorial Wing, with its extensive accommodation and modern equipment, possesses exceptional advantages for clinical work.

ENTRANCE SCHOLARSHIPS IN NATURAL SCIENCE.—One of £144, two of £78 15s., one of £52 10s., two of £57 15s. (for students from Oxford and Cambridge) will be awarded by Examination in September.

SPECIAL TUITION is provided for the various Examinations of the Universities of Oxford, Cambridge, and London, for the Fellowship of the Royal College of Surgeons, and for all the Final Examinations, without additional fees.

IMPROVED LABORATORIES.—The Physiological Laboratories have been further extended, and a Special Physiological Lecture Room for advanced practical classes has been added. New Pathological and Bacteriological Laboratories have also recently been provided, and the Chemical Laboratory enlarged.

PRELIMINARY SCIENTIFIC COURSE.—Special Classes, including Lectures and Laboratory Work, are held throughout the year. The prospectus, containing particulars of fees, &c., may be had on application to the Secretary.

H. A. CALEY, M.D., Dean.

ST. THOMAS'S HOSPITAL MEDICAL SCHOOL, ALBERT EMBANKMENT, S.E.

The SUMMER SESSION will commence on TUESDAY, May 1. Students entering in the Summer are eligible to compete for the Science Scholarships of £150 and £60 awarded in October.

A Scholarship of £50, open to University Students, and other Prizes and Scholarships of the value of £500 are offered for annual competition.

All Appointments are open to Students without extra payment. Special Classes for the Examinations of the University of London are held throughout the year.

Tutorial Classes are held prior to the Second and Final Examinations of the Conjoint Board in January, April, and July.

A Register of approved lodgings and of private families receiving Boarders is kept in Secretary's Office.

Excellent Day Club accommodation is provided in the School Building, and an Athletic Ground at Chiswick.

Prospectuses and all particulars may be obtained from the Medical Secretary, Mr. G. RENDLE.

H. P. HAWKINS, M.A., M.D. Oxon., Dean.

THE LONDON SCHOOL OF TROPICAL MEDICINE

(UNDER THE AUSPICES OF HER MAJESTY'S GOVERNMENT),
CONNAUGHT ROAD, ALBERT DOCK, E.

IN CONNECTION WITH THE HOSPITALS OF THE SEAMEN'S HOSPITAL SOCIETY.

The next SESSION commences on TUESDAY, MAY 1, 1905. For Prospectus, Syllabus, and other particulars, apply to the Secretary, P. MICHELLI, Esq., Seamen's Hospital, Greenwich, S.E.; or to Dr. Rees, the Medical Tutor, at the School.

UNIVERSITY COLLEGE, LONDON. FACULTIES OF ARTS AND LAWS AND OF SCIENCE.

DEANS:
Professor W. P. KER, M.A., LL.D. (Arts and Laws).
Professor VAUGHAN HARLEY, M.D. (Science).

The Third Term begins Tuesday, April 24th.
For prospectus, &c., apply to

J. M. HORSBURGH, M.A., Secretary.

Partner Wanted in a Scientific Manufacturing Business, with £1000 or upwards. Would suit Scientific Man or Son; exceptional opening; Capital wanted to carry out the Orders open, and—by enlarging Business—to avail of greatly increased trade waiting. Profits very large.—Address, "Scientific," care of NATURE Office.

BIRKBECK INSTITUTION, Breame Buildings, Chancery Lane, E.C.

Science Classes with Practical Work.

DAY AND EVENING CLASSES for University of London B.Sc.; Prelim. Scientific, Inter. M.B. Examinations and for Conjoint Board, Dental and Pharmaceutical Examinations.

EVENING CLASSES in all stages for Science and Art Department Examinations.

HIGHLY-EQUIPPED LABORATORIES.

Chemistry, Physics, Biology (Zoology and Botany), Metallurgy, Geology and Mineralogy, Microscopy.

Prospectus free. Calendar 6d. (Post 8d.) on application to Secretary.

ROYAL INSTITUTION OF GREAT BRITAIN,

ALBEMARLE STREET, PICCADILLY, W.

TUESDAY next, APRIL 24, at three o'clock, HUGH ROBERT MILL, Esq., D.Sc., LL.D., F.R.S.E., Librarian of the Royal Geographical Society. First of Three Lectures on "Studies in British Geography": (1) The English Lakes; (2) The Clyde Sea Area; (3) A Corner of Sussex. (The Tyndall Lectures.) Half-a-Guinea the Course.

THURSDAY, APRIL 26, at three o'clock, Prof. DEWAR, M.A., LL.D., F.R.S., M.R.I., Fullerton Professor of Chemistry, R.I. First of Four Lectures on "A Century of Chemistry in the Royal Institution." Half-a-Guinea the Course.

SATURDAY, APRIL 28, at three o'clock, STANLEY LANE-POOLE, Esq., M.A., M.R.I.A., Professor of Arabic at Trinity College, Dublin. First of Two Lectures on "Egypt in the Middle Ages." Half-a-Guinea the Course.

Subscription to all the Courses in the Season, Two Guineas.

Tickets may be had at the Office of the Institution.

The Friday Evening Meetings will be resumed on April 27th, at nine o'clock. The RIGHT HON. LORD KELVIN, G.C.V.O., D.C.L., LL.D., F.R.S., M.R.I., on "Nineteenth Century Clouds over the Dynamical Theory of Heat and Light." To these Meetings Members and their Friends only are admitted.

B.A. AND B.Sc. EXAMINATIONS.

MATRICULATION, INTERMEDIATE, FINAL.

PREPARATION by CORRESPONDENCE AND ORAL TUITION on a THOROUGHLY INDIVIDUAL SYSTEM. Fees based on success.

The STAFF includes Graduates of Oxford, Cambridge, London, and Royal Universities, Science Medalists, Prizemen, Scholars, &c.

SINGLE SUBJECTS TAKEN: Latin, Greek, French, German, Mathematics, Science, Logic, Psychology, Political Economy, &c.

For terms, &c., address Mr. J. CHARLESTON, B.A. (Lond. and Oxon.), The Burlington Classes, 27 Chancery Lane, London, W.C.

HEATHCOTE SCIENCE LABORATORIES.

These Laboratories are open for RESEARCH work, at any hours or times most convenient for workers, in CHEMISTRY, PHYSICS and BACTERIOLOGY. Facilities for Commercial investigations are supplied. Furnaces and powerful Electrical Currents can be used.

The Fees are at rate of £3 3s. for one month (five days a week, six hours a day). Apparatus supplied free.

Private Laboratory, £4 14s. 6d. a month, or by arrangement.

The above Fees include use of all ordinary Glass and other Apparatus, and use of Accurate Balances and Standard General Instruments, also Furnaces, &c.

9 Heathcote Street, Mecklenburgh Square, | R. C. T. EVANS,
Gray's Inn Road, W.C. | Director.

BOTANICAL MATERIAL FOR CLASS WORK, RESEARCH AND PRIVATE STUDENTS.

J. BACKHOUSE & SON, LIMITED, YORK,

Having now established their new Scientific Department and Experimental Laboratory, are prepared to send Post free on application their new

50 PAGE CATALOGUE,

comprising Cryptogamic and Phanerogamic Material, fresh or preserved; Museum Specimens; Microscopical Preparations; &c., &c.

BARGAINS IN SCIENTIFIC BOOKS.

CAMPBELL (D. H.), THE STRUCTURE

AND DEVELOPMENT OF THE MOSSES AND FERNS (ARCHÉGONIATÆ). By DOUGLAS HOUGHTON CAMPBELL, Ph.D. Fully Illustrated. Medium 8vo. (Pub. 14s. net.) 4s.

"Dr. Campbell's book is clearly written, well illustrated, is provided with an accurate bibliography and a copious index, so that it will take its place at once as a standard classic, and will, we think, retain that position for no inconsiderable period."—*Gardener's Chronicle*.

BATESON (W.), MATERIAL FOR THE

STUDY OF VARIATION, treated with especial regard to Discontinuity in the Origin of Species. By WILLIAM BATESON, M.A., Fellow of St. John's College, Cambridge. 8vo, Cloth. (Pub. 21s. net.) 5s.

"The whole work must be carefully read by every serious student; and there can be no question of its great and permanent value as a contribution to our knowledge of a particular class of variations, and as a stimulus to further work in a department of knowledge which is too much neglected."—*Nature*.

HEADLEY (F. W.), THE STRUCTURE

AND LIFE OF BIRDS. By F. W. HEADLEY, M.A., F.Z.S., Assistant Master in Haileybury College. With 78 Illustrations. Crown 8vo, Cloth. (Pub. 7s. 6d.) 1s. 6d.

"We know of no book, at any rate, no modern book, which covers precisely the ground of Mr. Headley's Manual; it strengthens decidedly a weak point in Ornithological literature, and this fact, coupled with the excellence of the illustrations, should ensure for it a wide circulation."—*Ibis*.

COUES (Prof. ELLIOTT), HANDBOOK

OF FIELD AND GENERAL ORNITHOLOGY, a Manual of the Structure and Classification of Birds, with Instructions for Collecting and Preserving Specimens. Illustrated. Demy 8vo, Cloth. (Pub. 10s.) 2s. 6d.

The volume consists of two distinct parts:—PART I.—Field Ornithology contains the necessary Instructions for the Observation and Collection of Birds in the field, and for the Preparation and Preservation of Specimens for scientific study in the Cabinet. PART II.—General Ornithology is a technical Treatise of the Classification, the Zoological Characters, and the Anatomical Structure. CHAPTERS.—Implements for Collecting and their Use—Dogs—Suggestions and Directions for Field-work—Hygiene of Collectorship—Registration and Labelling—Instruments—Materials and Fixtures—How to make a Bird-skin—Collection of Nests and Eggs—Care of a Collection—Definition of Birds—Principles and Practice of Classification—Definitions and Descriptions of the Exterior Parts of Birds—An Introduction to the Anatomy of Birds.

Inland Postage 3d. extra on one, or 6d. on four.
H. J. GLAISHER, New and Remainder Bookseller, 57 Wigmore Street, London, W.

Catalogues Post Free on application.

ECLIPSE OF THE SUN.

COOK'S SELECT CONDUCTED TOURS

TO NAVALMORAL TO ALGIERS,

Including

PARIS, BORDEAUX,
BIARRITZ, MADRID, &c.

Inclusive Fare, £30.

By short Sea Route *via*
DOVER and CALAIS, including

PARIS, MARSEILLES,
ALGIERS, BLIDAH,
GORGE OF CHIFFA, &c.

Inclusive Fare, 29 Guineas.

LEAVING LONDON, MONDAY, MAY 21ST.

Including First Class Rail and Steamer Tickets for the Round; First-class Hotel Accommodation; Omnibuses to and from Hotels while with the Conductors; Carriage Excursions; Fees to Hotel and Railway Servants; and Admission Fees at all places of interest visited with the Conductors.

PROGRAMMES FREE ON APPLICATION.

INDEPENDENT TICKETS BY ALL ROUTES.

THOS. COOK & SON,
LUDGATE CIRCUS, LONDON,
AND BRANCH OFFICES.

A. AND C. BLACK'S LIST.

A TREATISE ON ZOOLOGY.

By E. RAY LANKESTER, M.A., LL.D., F.R.S., Hon. Fellow of Exeter College, Oxford; Director of the Natural History Departments of the British Museum; Fullerian Professor of Physiology and Comparative Anatomy in the Royal Institution of London. Profusely Illustrated. To be completed in Ten Parts. NOW READY. Part III. THE ECHINODERMA. By F. A. BATHER, M.A., assisted by J. W. GREGORY, D.Sc., and E. S. GOODRICH, M.A. Demy 8vo, paper covers, price 12s. 6d. net; cloth, price 15s. net.

"It is marked by three characteristics, which indeed may be regarded as now indispensable to any scientific work of value—perfect lucidity in the illustrations, which are numerous, and, of course, specially drawn by, or under the direction of, the author; a careful exposition of the historical development of life-forms; and complete bibliographies on each branch of the subject."—*Literature*.

NOW READY. Demy 8vo, cloth, price 12s. 6d. net.

SEXUAL DIMORPHISM IN THE ANIMAL KINGDOM.

A Theory of the Evolution of Secondary Sexual Characters. By J. T. CUNNINGHAM, M.A. Containing 32 Illustrations.

"Mr. Cunningham has elaborated a theory of evolution in answer to the problem: What are the causes which have produced the three kinds of structural difference in animals? He supports his theory by facts and illustrations drawn mainly from the works of others. A book of distinct scientific importance. The present volume is well printed and profusely illustrated with carefully executed figures."—*The Outlook*.

NOW READY. Crown 8vo, cloth, price 3s. 6d.

INTRODUCTION TO STRUCTURAL BOTANY.

Part II. Flowerless Plants. Third Edition. By D. H. SCOTT, M.A., Ph.D., F.R.S., Honorary Keeper of the Jodrell Laboratory, Royal Gardens, Kew.

"It stands out from the ever-increasing crowd of guides, text-books, and manuals, in virtue not only of originality of design, but also of the fact that the subjects treated have been specially investigated for the purpose of the book, so that we have not the mere compilation of a book-man, but an account based on the results of the author's own observation."—*Natural Science*.

NOW READY. Post 8vo, cloth, price 12s. 6d.

ALGEBRA. An Elementary Text-book for

the Higher Classes of Secondary Schools and Colleges. Part II. Second Edition. By Prof. GEORGE CHRYSAL, M.A., LL.D.

"The merits of the work are so well known that it is unnecessary to more than announce the publication of the new edition."—*Nature*.

NOW READY. Demy 8vo, cloth, price 7s. 6d. net.

THE GRAMMAR OF SCIENCE.

By KARL PEARSON, M.A., F.R.S., Professor of Applied Mathematics and Mechanics in University College, London. Second Edition, thoroughly Revised and much Enlarged. Contains Two entirely New Chapters on Natural Selection and Heredity, embracing a Popular Account of Prof. Pearson's own more recent work in this direction. Containing 33 Illustrations in the Text.

"It is still a grammar in that it deals with the foundations of science; but a far more ambitious title might have been given to so comprehensive a work."—*The Bookman*.

NOW READY. Demy 8vo, cloth, price 10s. 6d.

TEMPERATE CHILE: a PROGRESSIVE

SPAIN. By W. ANDERSON SMITH, formerly Special Commissioner to the Chilean Government to Report on their Rivers.

"The book is both charming and valuable."—*Nature*.

A. AND C. BLACK, SOHO SQUARE, LONDON.

CARL ZEISS,

MANUFACTURER OF

MICROSCOPES; TELESCOPES (ASTRONOMICAL and TERRESTRIAL); PRISM FIELD GLASSES; TELEMETERS; PHOTOGRAPHIC OBJECTIVES; and OPTICAL MEASURING INSTRUMENTS, including COMPARATORS, REFRACTOMETERS, BUTTER-REFRACTOMETERS, SPECTROMETERS, &c.

LONDON BRANCH:

29 MARGARET ST., CAVENDISH SQUARE, W.

Telegrams:—DIACTINIC, London.

CATALOGUES POST FREE. KINDLY SAY WHICH REQUIRED.

SPECTROSCOPES.

For:—

GENERAL EXPERIMENTAL WORK.
ABSORPTION WORK.
CHEMICAL ANALYSIS.
ULTRA-VIOLET WORK (with Complete Quartz Train)
SPECTRAL PHOTOGRAPHY.
ZEEMAN EFFECT OBSERVATIONS by aid of
MICHELSON'S ECHELON GRATING.
MICROSCOPIC WORK.

CAMERAS ADAPTED TO ANY SPECTROSCOPE.

Spectroscopes Designed for any purpose.

PRICE LIST OF SPECTROSCOPES SENT ON APPLICATION.

ADAM HILGER, 204 Stanhope St., London, N.W.

GAMBRELL BROTHERS,

17 Giltspur Street, LONDON, E.C.

Telegrams: "GAMBREUM, LONDON."

Electricians and Manufacturers of
HIGH GRADE ELECTRICAL AND PHYSICAL APPARATUS.
QUOTATIONS ON APPLICATION FOR ANY SPECIAL FORM OF APPARATUS.
WRITE FOR PRICE LIST.

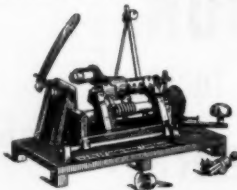
W. G. PYE & CO.,**"GRANTA" WORKS, MILL LANE, CAMBRIDGE.**

MAKERS OF PHYSICAL, PHYSIOLOGICAL, AND OTHER SCIENTIFIC INSTRUMENTS.

Sole Makers of Leake's Patent
Flat-cutting Rocking Microtome.
Unsurpassed for ordinary work,
unequalled for Botanical work.

Price, as illustrated, in Case,

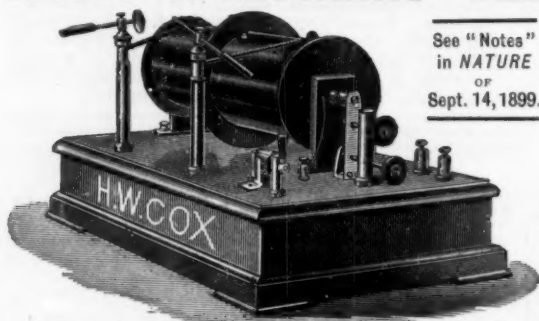
£6. 6 0



LEAKE'S PATENT MICROTOME.

CAMBRIDGE PATTERN Rocking
Microtome, in Case, £3 5s.
Resistance Boxes from £3.
Improved Reflecting Galvanometers,
£3.
School Galvanometers from 10s. 6d.

PYE'S Improved Pattern Boyle's Law Apparatus ... £1 5 0 As shown at the recent Educational Exhibition at South Kensington with the Cambridge University Exhibits.
" " " Constant Volume Air Thermometer 0 15 0
" " " PRICE LISTS AND PAMPHLETS ON APPLICATION. (ILLUSTRATED CATALOGUE IN PREPARATION.)

X-RAY & ÆTHERIC TELEGRAPHY APPARATUS

See "Notes"
in NATURE
OF
Sept. 14, 1899.

OF THE HIGHEST QUALITY AND FINISH ONLY,
As supplied by us to H.M. Government and the leading
Hospitals and X-Ray Workers throughout the World.

We are the actual Manufacturers, and Guarantee
every Coil against breaking down.

CALL OR WRITE FOR OUR NEW ILLUSTRATED LIST, WITH
TESTIMONIALS AND ILLUSTRATED INSTRUCTIONS UPON HOW
TO WORK. POST FREE TO READERS OF "NATURE."

HARRY W. COX, Ltd.,
10, 11, 28 CURSITOR STREET,
CHANCERY LANE, LONDON.

Radiographs taken for Scientific and Medical Men, and
Demonstrations given.

NOW READY.

Tenth Edition. Illustrated with numerous Plates and Diagrams.
Pp. 502. Cr. 8vo. Cloth, 6s. net.**INSTRUCTION IN PHOTOGRAPHY.**

BY

Sir W. de W. ABNEY, K.C.B., D.C.L., F.R.S.

Revised and greatly enlarged, bringing the book up to date, and including additional chapters on Photo-block Work, Three-colour Work, Hand Camera and Film Photography, Paper Processes, New Developers, &c., &c.

London: SAMPSON LOW, MARSTON & COMPANY, Limited,
St. Dunstan's House, Fetter Lane, Fleet Street, E.C.LATEST PUBLICATIONS OF THE ZOOLOGICAL
SOCIETY OF LONDON.**PROCEEDINGS OF THE ZOOLOGICAL
SOCIETY OF LONDON, 1899.** Part IV. Containing Papers read
at the Scientific Meetings held in November and December 1899.
With 18 Plates. Price to Fellows, 9s.; to the Public, 12s.To be obtained at the Society's Office (3 Hanover Square, W.), or through
any Bookseller.

Now Ready. 8vo. Price 4s. net.

**INORGANIC EVOLUTION
AS STUDIED BY
SPECTRUM ANALYSIS.**

BY

SIR NORMAN LOCKYER, K.C.B., F.R.S.

MACMILLAN AND CO., LTD., LONDON.

**T. TAMBLYN-WATTS,
SCIENTIFIC APPARATUS MAKER.**Apparatus suitable for School use a Speciality.
Every Material required in the Physical Laboratory supplied.
*Electrical and Mechanical Catalogues, 6d. Post free.***GOLDIELANDS, SETTLE, YORKS.****LETCHER & SONS (formerly Letcher Bros.),
SCIENTIFIC INSTRUMENT MAKERS,
25 TURNPIKE LANE, HORNSEY, N.****BLOWPIPE CABINETS. SPECIALITY: SOCIETY OF ARTS SETS.**
*PRICE LIST, POST FREE, ON APPLICATION.***Sale by Auction.**

MONDAY, APRIL 23.

THE REMAINING PORTION OF THE "SAMUEL STEVENS"
COLLECTION.**MR. J. C. STEVENS will Sell by Auction,**
at his Great Rooms, 38 King Street, Covent Garden, on Monday,
April 23, the remaining portion of the well-known Collection of British
Lepidoptera formed by the late SAMUEL STEVENS, Esq., F.E.S.,
F.L.S., comprising the Micro-Lepidoptera, the Supplementary Series
of Macros and the Duplicates, together with the Cabinets, Books, &c.,
appertaining to the Collection.On View Saturday prior, from 10 till 4, and Morning of Sale. Catalogues
on application, post free.**THE JOURNAL OF ANATOMY AND
PHYSIOLOGY,
NORMAL, AND PATHOLOGICAL, HUMAN
AND COMPARATIVE.**

CONDUCTED BY

PROFS. TURNER, CUNNINGHAM, HUNTINGTON,
MACALISTER, and M'KENDRICK.

Vol. XXXIV.—New Series, Vol. XIV. Part III.—APRIL 1900.

Now Ready. Price 6s.

With Plates and Figures in Text.

CONTENTS OF PART III.—APRIL 1900.

- 1.—Johnson Symington, M.D. Separate Acromion Process.
- 2.—J. Kingston Barton, M.R.C.P. Anatomy of Digestive Tract in
Salmo Salar. (Plates XL.—XLIII.)
- 3.—F. G. Parsons, F.R.C.S. Joints of Mammals compared with those of
Man. Part II.
- 4.—A. A. Gray, M.D. Modification of Helmholtz Theory of Hearing.
- 5.—W. Myers, M.B. Causes of Shape of Non-Nucleated Red Blood
Corpuscles.
- 6.—N. Bishop Harman, M.B. Anterior Limit of Cervico-Thoracic
Visceral Efferent Nerves in Man. (Plates XLIV.—XLIX.)
- 7.—W. H. Wynn, B.Sc. Minute Structure of Medullary Sheath of
Nerve-Fibres. (Plates L., LI.)
- 8.—T. W. Shore, M.D. Unusual Arrangement of Renal Portal Vein in
Frog.
- 9.—R. Tait M'Kenzie, M.D. Dissection of Two Club Feet.
- 10.—Bertram C. A. Windle, M.D. Tenth Report on Recent Teratological
Literature.
- 11.—C. M. Cooper, M.B. Pericardial Sac, in which the Large Azygos
Vein pierced the Sac before opening into the Superior Vena Cava.
- 12.—Proceedings of the Anatomical Society of Great Britain and Ireland.

London: CHARLES GRIFFIN & CO., Ltd., Exeter Street, Strand.

Verlag von Gustav Fischer in Jena.

Soeben erschien:

**UNTERSUCHUNGEN ÜBER DEN BAU DER
BRACHIOPODEN.**

ZWEITER TEIL.

Die Anatomie von Discinisca Lamellosa (Broderip)
und Lingula Anatina Bruguière.

Von

DR. FRIEDRICH BLOCHMANN,

Professor an der Universität Tübingen.

Mit einem Atlas von 12 lithographischen Tafeln und 14
Abbildungen im Text.

Preis: 30 Mark.

Preis für das vollständige Werk: 55 Mark.

UNIVERSITY OF GLASGOW.

EXAMINERSHIP IN MEDICINE.

The University Court of the University of Glasgow will shortly proceed
to appoint an Examiner for Degrees in Medicine, with special qualifications
to examine in Practice of Medicine (Systematic and Clinical).
The Appointment will be till 31st December, 1903, at an annual salary
of £50.Candidates should lodge twenty copies of their Application and Testi-
monials with the undersigned on or before 23rd May.

ALAN E. CLAPPERTON,

Secretary of the Glasgow University Court.

91 West Regent Street, Glasgow.

SCHOLASTIC.—Wanted, Science Masters,
as follows:—Chemistry, Physics and Low Form work—important
Grammar School, £150, non-res.; Chemistry and Physics for School
of Science, £120, non-res.; Chemistry and Physics for County School
salary about £120, non-res.; Certificated Science Master for London
School, £100, non-res.—Address, GRIFFITHS and Co., Tutorial
Agents, 34 Bedford Street, Strand.**THE IRISH NATURALIST.****A Monthly Magazine of Irish Zoology, Botany, and
Geology. Price 6d.**Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD
PRAEGER, B.A.

Annual Subscription, 5s. Post Free to any Address.

Dublin: EASON & SON, Ltd., 40 Lower Sackville Street
(to which Address Subscriptions should be sent).

London: SIMPKIN, MARSHALL, HAMILTON, KENT, & CO., Ltd.

DUDELL OSCILLOGRAPH.

An Invaluable Instrument for
Alternate Current Work.

This Galvanometer has the shortest
periodic time of any Instrument
yet constructed, viz. 0.0001 Second,
is perfectly dead-beat, and the self-
induction is practically nil.

WRITE FOR DESCRIPTIVE PAMPHLET.

SOLE MAKERS—
SCIENTIFIC INSTRUMENT CO.
LIMITED,
CAMBRIDGE.

TO GET BEST RESULTS IN PHOTOGRAPHY
USE
MARION'S
Plates, Papers, and Cameras.

.....
THE PERFECTION CAMERA with 3 double backs
and tripod. $6\frac{1}{2} \times 4\frac{3}{4}$, 165s.; $8\frac{1}{2} \times 6\frac{1}{2}$, 195s.

THE RADIAL HAND CAMERA. New and Im-
proved Form $\frac{1}{4}$ -plate, £8 8s.

THE "SWALLOW." New $\frac{1}{4}$ -plate size, 21s.

THE CUT FILM SWALLOW for 30 $\frac{1}{4}$ -plate films.
Single Lens, 50s.

THE "CAMRANA." No. 2, complete. Lens, shutter,
and 3 double backs, $\frac{1}{4}$ -plate, £6 6s.

THE PRESTO CAMERA. Loaded with film for 24
exposures, $1\frac{1}{4} \times 1\frac{1}{4}$, and carrier for 4 plates, 10s. 3d., post
free.

PANAK. A new Sensitizing Solution, can be applied with
a brush to Cards, Paper, Silk, &c., 2s. 6d. per bottle.

MARION'S NEW QUICK PRINT PAPERS.
Give charming results independent of daylight.

.....
MARION & CO.,
22 & 23 SOHO SQUARE, LONDON, W.

A REALLY SCIENTIFIC AND PRACTICAL NOVELTY.

THE "EVER READY" ELECTRIC TORCH

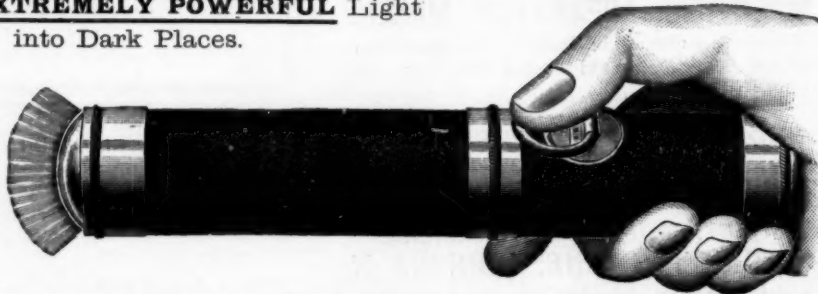
Shoots an EXTREMELY POWERFUL Light
into Dark Places.

SIMPLICITY
ITSELF.

No Wires.

No Chemicals.

No Danger.



THE MOST SERVICEABLE ELECTRIC LIGHT YET INVENTED.

MATCHES, TAPERS, CANDLES, HAND-LAMPS (Always a Danger) ENTIRELY SUPERSEDED.
No Leak—No Liquid. Wind Proof—No Flame. Fire Proof—No Heat.

Non-Explosive—No Gas or Dangerous Chemicals.

A CHILD CAN USE IT.

Ready to pour a Flood of Light about your bedroom, along dark halls, stairways, and cellars, at any instant.

A SEARCH-LIGHT into Dark Corners unequalled for HOUSEHOLD PURPOSES.

PENETRATES all RECESSES, CUPBOARDS, and LOCKERS for HOUSEWIVES.

CHEAP. CLEAN. EFFECTIVE.

IT'S A USEFUL, HARMLESS BUSYBODY.

Size No. 1. Price (with Battery complete) 18s. Size No. 1. Extra Battery, 1s. 6d. Larger sizes, 25s. and 30s. each.
After 6000 to 8000 flashes then "refill" batteries can be slipped in at a moment's notice, and torch is as good as new.

W. & J. GEORGE, LTD., 33-37 HATTON WALL, LONDON.
(Late F. E. BECKER & CO.)

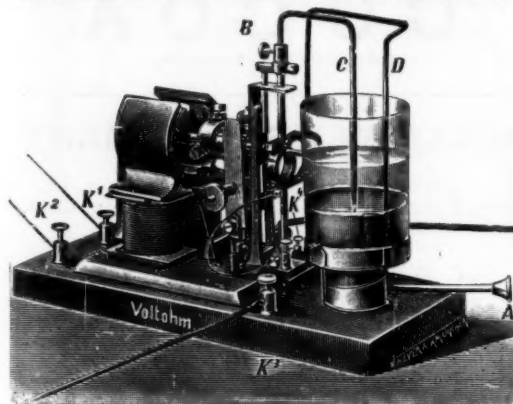
ISENTHAL, POTZLER & CO.,

85 MORTIMER STREET, LONDON, W.

Telegrams: "HYSTERESIS."

Telephone: 2099, GERRARD.

CENTRAL DEPOT FOR RADIOGRAPHERS.



MERCURY BREAK.

Write for Lists, or better inspect our Installations.
HIGHEST REFERENCES.

EVERYTHING NOVEL AND ORIGINAL.

Sole Agents for Scotland:

Messrs. JAMES WHITE,
Cambridge Street, Glasgow.

NEW SCIENCE LANTERN.

SOLE MAKERS:
REYNOLDS & BRANSON,
Ltd.

IMPROVED
PORTABLE
DESIGN.



The Universal Science Lantern has been devised for the projection of experiments. In the short box in front of the lantern is a hinged mirror, so placed that by the movement of a stud it may be introduced and placed at an angle of 45 degrees with the parallel beam. The beam is thus sent upwards through a horizontal convergent lens, on which a slide or horizontal piece of apparatus can be placed. Above this is the objective mounted on a brass pillar, and above the objective a prism or mirror (if the screen is elevated above the lantern plain prisms are required for each beam), silvered on the outside so that there is no double reflection. The mirror can be adjusted to any angle, and is intended to send the image in an approximately horizontal direction to the screen. Slides can also be directly projected in the usual way.

The base-board is made to fold so that the lantern can be packed into a box 18½ x 8½ x 20½ with all its accessories *in situ*.

Price Complete, in Travelling Box, £9 0 0

REYNOLDS & BRANSON, LTD.
14 COMMERCIAL STREET, LEEDS.

L. CASELLA,

Scientific Instrument Maker,
Engineer, &c.



THEODOLITES.
LEVELS.
SEXTANTS
HORIZONS.
COMPASSES.
TELEMETERS.
TIDE GAUGES.
STEAM AND PRESSURE
GAUGES.
ANEROIDS.
&c., &c.

PARTICULARS AND PRICES MAY BE
HAD ON APPLICATION.

WRITE FOR DESCRIPTIVE PAMPHLETS AND CATALOGUES
OF SURVEYING INSTRUMENTS, &c.

147 Holborn Bars,
LONDON, E.C.

Telegraphic Address:—"ESCUTCHEON, LONDON."
Telephone:—No. 1054. HOLBORN.

OBSERVATIONS AND - - - SCIENTIFIC INVESTIGATIONS

Can be performed easily
and quickly, and impor-
tant facts and deductions
neatly and legibly re-
corded, with the aid of a
Writing Machine. The
one that will enable the
Scientist to obtain the
best results, and give
him the greatest satisfac-
tion, is undoubtedly that
Marvel of Mechanical
Skill,



THE
YOST
TYPE-
WRITER.

For full particulars of this wonderful Instrument, send
for Illustrated "E" Catalogue to

The YOST TYPEWRITER Co., Ltd.,
50 HOLBORN VIADUCT,
London, E.C.

WEST END DEPOT:—303 Oxford Street.

THE ENTOMOLOGIST:
AN ILLUSTRATED JOURNAL OF GENERAL ENTOMOLOGY.

Edited by RICHARD SOUTH, F.E.S.,

With the Assistance of

ROBERT ADKIN, F.E.S.

T. R. BILLUPS, F.E.S.

W. LUCAS DISTANT, F.E.S., &c.

EDWARD A. FITCH, F.L.S., F.E.S.

F. W. FROHAWK, F.E.S.

MARTIN JACOBY, F.E.S.

J. H. LEECH, B.A., F.L.S., F.E.S.

DR. D. SHARP, F.R.S., F.E.S., &c.

G. H. VERRALL, F.E.S.

W. WARREN, M.A., F.E.S.

W. F. KIRBY, F.E.S.

Founded by the late Edward Newman in 1840, this Journal has been the popular organ of British Entomologists since 1864. Its contents deal chiefly with the home fauna, but there are frequent articles and notes on matters of interest pertaining to the Entomology of various parts of the world. Published on the first of each month. Price 6d. Subscription, 6s. per annum post free to any country.

London: WEST, NEWMAN, & CO., 54 Hatton Garden, E.C.

On the 1st of every Month. Greatly Enlarged.

THE JOURNAL OF BOTANY.

BRITISH AND FOREIGN.

Edited by JAMES BRITTEN, F.L.S., British Museum.

CONTENTS:—Original Articles by leading Botanists.—Extracts, and Notices of Books and Memoirs.—Articles in Journals.—Botanical News.—Proceedings of Societies.

The enlargement has made room for many Cryptogamic and other useful and interesting papers which have accrued since the discontinuance of "*Grevillea*."

Price 1s. 8d. Subscription for One Year, payable in advance, 16s.

London: WEST, NEWMAN, & CO., 54 Hatton Garden, E.C.

THE MOST NUTRITIOUS.

EPPS'S

GRATEFUL—COMFORTING.

COCOA

BREAKFAST—SUPPER.

HOLLOWAY'S OINTMENT

CURES

Gout, Rheumatism, Lumbago, Sciatica, Cuts, Bruises, Sprains, &c.

INVALUABLE FOR ALL SKIN DISEASES.

Holloway's Ointment and Pills may be obtained of all Medicine Vendors.

MACMILLAN & CO.'S NEW SCIENTIFIC BOOKS.
MICRO-ORGANISMS AND FERMENTATION.

By ALFRED JÖRGENSEN,

Director of the Laboratory for the Physiology and Technology of Fermentation at Copenhagen. Translated by ALEX. K. MILLER, Ph.D., F.I.C., and A. E. LENNHOLM. Third Edition, completely Revised. With 83 Illustrations. 8vo. 10s. net.

TEXT-BOOK OF PALÆONTOLOGY.

By KARL A. VON ZITTEL,

Professor of Geology and Palæontology in the University of Munich. Translated and Edited by CHAS. R. EASTMAN, Ph.D., Assistant in Palæontology in the Museum of Comparative Zoology at Harvard. With 1476 Woodcuts. Medium 8vo. 25s. net.

* * * This English Edition is revised and enlarged by the Author and Editor in collaboration with numerous Specialists.

FIELD.—"An admirable introduction to the study of those fossils or petrified organic remains of plants and animals which existed before the present geological period and the advent of man on the face of the globe. . . . Will be of the greatest possible assistance to all geological students. . . . Too much praise cannot be bestowed on the accuracy and beauty of the illustrations."

AN ELEMENTARY COURSE OF PRACTICAL ZOOLOGY.

By the late T. JEFFERY PARKER, D.Sc., F.R.S., Professor of Biology in the University of Otago, Dunedin, New Zealand, and W. NEWTON PARKER, Ph.D., Professor of Zoology at the University College of South Wales and Monmouthshire, in the University of Wales. With 156 Illustrations. Crown 8vo. 10s. 6d.

LANCET.—"Will be found serviceable to the upper classes of schools where natural history is taught, and to classes for elementary biology in medical schools."

A MANUAL OF ZOOLOGY.

By the late Prof. T. J. PARKER, D.Sc., F.R.S., and Prof. W. A. HASWELL, M.A., D.Sc., F.R.S.

With Three Hundred Illustrations. Crown 8vo, 10s. 6d.

ZOOLOGIST.—"The present publication may be considered a condensation of the previous work ('A Text-Book of Zoology'). . . . Thus we have the essence of a really good book in a convenient form for teachers and students."

KNOWLEDGE.—"The text is accompanied by about three hundred beautiful illustrations. . . . The treatment is explicit throughout, and the book is sure to gain a wide popularity."

THE PRINCIPLES OF MECHANICS PRESENTED IN A NEW FORM.

By HEINRICH HERTZ,

Late Professor of Physics in the University of Bonn. With an Introduction by H. VON HELMHOLTZ. Authorised English Translation by D. E. JONES, B.Sc., District Inspector under the Department of Science and Art, &c., and J. T. WALLEY, M.A. 8vo. 10s. net.

ENGINEER.—"A very remarkable book. . . . A book which it is impossible to pass over in silence, fraught as it is with infinite possibilities of the future. It represents the latest work of one of the finest intellects of the century."

MACMILLAN AND CO., LIMITED, LONDON.

Apparatus or estimation of sulphur in pent oxide.

**FREDK. JACKSON & Co.**

(Late MOTTERSHEAD & CO.)

14 CROSS STREET, MANCHESTER.

Goods Entrance: 10 Half-Moon Street,

LABORATORY FURNISHERS,Importers, Manufacturers, and Dealers in
**CHEMICAL AND PHYSICAL
APPARATUS**

Of every Description.

Fine Chemicals, Volumetric Solutions
Plain and Stoppered Bottles,

AND EVERY LABORATORY REQUIREMENT.

Illustrated Catalogue of Apparatus, with Price List
of Chemicals, free on application.

Telegraphic Address—"APPARATUS, MANCHESTER."

Telephone Number—2038.

TO SCIENCE LECTURERS.**HUGHES' MOTO-PHOTOGRAPH FOR LIVING PICTURES.**

THE MOST PERFECT.

No SHUTTER, therefore no Flickering. Superb Mechanism.

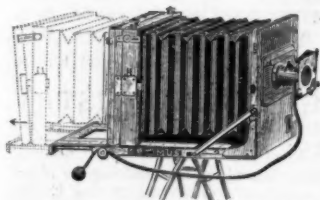
The Moto-Photo Camera for taking the Pictures. Illustrated Lists, ad.
See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN,
&c. Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great
success. New Oxyhydrogen Microscope. Science Lanterns for Class
Demonstration. Magnificent Results. Dovers Triple, Prize Medals
Highest Award. Supplied to the Royal Polytechnic Institution, Dr. H. GRAT-
TAN GUINNESS, Madame ADELINA PATTI, &c. &c. Patent Pamphongo,
Science Lanterns. The Universal Lantern 4-inch Condensers, 4-wick Lamp,
Portrait Combination front Lenses, 18s. 6d., Marvellous value. Science
Lecture Sets. Novelties. The Lantern Kaleidoscope. Cheapest Lantern
Outfits in the World. Grandly Illustrated Catalogue, over 180 choice En-
gravings, 6d.; Postage, 3d. List of 300 Lecture Sets, Science Subjects,
Views, &c., 6d.; Postage 3d. Pamphlets Free. W. C. HUGHES,
SPECIALIST, Brewster House, 85 Mortimer Road, Kingsland, N.

ALBERT EDWARD JAMRACH

(Late CHARLES JAMRACH),

NATURALIST,

180 ST. GEORGE STREET EAST.

Implements of Savage Warfare, Idols, Sacred Masks, Peruvian Pottery,
Netsukis China, Lacquers, Gongs, Shells, and other Curios.TRADE
MARK**"OPTIMUS."**TELEGRAPHIC
ADDRESS.**PHOTOGRAPHIC
APPARATUS**OF BEST WORKMANSHIP
FOR ALL PURPOSES.

Catalogue POST FREE.

**PERKEN, SON & CO., LTD.,** 99, HATTON GARDEN, **LONDON.**
HOLBORN CIRCUS, E.C.**HARVEY & PEAK**

(BY APPOINTMENT TO THE ROYAL INSTITUTION OF GREAT BRITAIN)

HAVE FOR DISPOSAL A NUMBER OF

NICOL PRISMS AND TOURMALINES of various Sizes.**PROJECTION POLARISCOPE**s of various Sizes in Stock, with large Nicol Prisms:—**STUDENTS' SPECTROMETERS.**—P. O. Bridge Sets, for Schools.—Induction Coils.—Wimshurst Machines.—X-Ray Apparatus.—Optical Banks, &c., &c.
H. & P. are the actual Manufacturers of the above.**56 CHARING CROSS ROAD, LONDON, W.C.****MOORE'S HYDROSTATIC BALANCE**FOR ILLUSTRATING THE "PRINCIPLE OF
ARCHIMEDES" AND SPECIFIC GRAVITY.A is a delicate spring balance accurately graduated to
read Grams, and is capable of being lowered or raised
by the string shown.B is one of the set of cubes of various metals supplied
with the apparatus.C is a glass vessel with fixed mark etched in glass, up
to which water, or other liquid, is placed. The
vessel is provided with draw-off cock.

Sole Makers of this Apparatus—

BREWSTER, SMITH, & CO.,

6 CROSS STREET, FINSBURY, E.C.

Manufacturers and Importers of Chemical and Scientific
Apparatus and Pure Chemicals.

WEIGHTS a Speciality, 500 Milligrams to

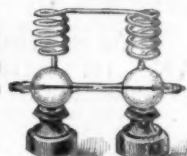
1 Milligram, 12. 6d. per doz.

SEND FOR COMPLETE ILLUSTRATED
CATALOGUE.**SECOND-HAND MICROSCOPES**By SWIFT, WATSON, CROUCH, BECK, ZEISS, LEITZ, &c.
Prices from **£2 10s.** to **£45.**A Large Selection of Second-hand Powers and Fittings for all kinds of
Microscopes.

Send for New List.

CLARKSON & CO., 28 Bartlett's Buildings, Holborn Circus, E.C.**GLASS BLOWING.**All kinds of Experimental Glass
Blowing carried out for Scientific
Men, Laboratories, &c.

INVENTORS' IDEAS WORKED OUT AS PER INSTRUCTIONS.

COSSOR,
67 Farringdon Road, E.C.Hittorff's Tube showing the
resistance of the dark space.

MACMILLAN & CO.'S BOOKS FOR STUDENTS OF CHEMISTRY.

AN INTRODUCTION to the STUDY

OF CHEMISTRY. By Prof. W. H. PERKIN, JR., Ph.D., F.R.S., and BEVAN LEAN, D.Sc., B.A. (Lond.). Globe 8vo, 2s. 6d.

CHEMISTRY FOR ORGANISED

SCHOOLS OF SCIENCE. By S. PARRISH, B.Sc., A.R.C.S. (Lond.). With Introduction by Dr. FORSYTH, Globe 8vo, 2s. 6d.

INORGANIC CHEMISTRY for BE-

GINNERS. By Sir HENRY E. ROSCOE, F.R.S. Assisted by JOSEPH LUNT, B.Sc. Globe 8vo, 2s. 6d.

INORGANIC CHEMISTRY FOR

ADVANCED STUDENTS. By Sir H. E. ROSCOE, F.R.S., and Dr. A. HARDEN. Globe 8vo, 4s. 6d.

LESSONS IN ELEMENTARY CHE-

MISTRY, INORGANIC and ORGANIC. By Sir H. E. ROSCOE, F.R.S. Sixth Edition, thoroughly revised. Fcap. 8vo, 4s. 6d.

A TREATISE on CHEMISTRY. By

Sir H. E. ROSCOE, F.R.S., and the late C. SCHOR-LEMMER, F.R.S. New Edition. Completely revised by Sir H. E. ROSCOE, assisted by Drs. H. G. COLMAN and A. HARDEN. Vol. I. The Non-Metallic Elements. 8vo. 21s. Vol. II. The Metals, 31s. 6d. Vol. III. Organic Chemistry. Parts I, II, IV., and VI., 21s. each. Parts III. and V., 18s. each.

CHEMICAL THEORY FOR BE-

GINNERS. By LEONARD DOBBIN, Ph.D., and JAMES WALKER, Ph.D., D.Sc. Fcap. 8vo, 2s. 6d.

AN INTRODUCTION TO THE

SCIENCE AND PRACTICE OF QUALITATIVE CHEMICAL ANALYSIS, INORGANIC. By CHAPMAN JONES, F.I.C., F.C.S. (London and Berlin), &c. Crown 8vo, 6s.

PRACTICAL INORGANIC CHE-

MISTRY FOR ADVANCED STUDENTS. By CHAPMAN JONES, F.I.C., F.C.S. (London and Berlin). Globe 8vo, 2s. 6d.

* PRACTICAL INORGANIC CHE-

MISTRY. By G. S. TURPIN, M.A., Globe 8vo, 2s. 6d.

LESSONS IN ORGANIC CHEMIS-

TRY. Part I., Elementary. By G. S. TURPIN, M.A., D.Sc. 2s. 6d.

The RISE and DEVELOPMENT of

ORGANIC CHEMISTRY. By CARL SCHOR-LEMMER, LL.D., F.R.S. Revised Edition. Edited by A. SMITHHELLS, B.Sc. Crown 8vo, 5s. net.

A TEXT-BOOK of INORGANIC

CHEMISTRY. By Prof. IRA REMSEN. 8vo, 16s.

INORGANIC CHEMISTRY. By Prof.

I. REMSEN. Crown 8vo, 6s. 6d.

ORGANIC CHEMISTRY. By Prof.

I. REMSEN. Crown 8vo, 6s. 6d.

The ELEMENTS of CHEMISTRY.

By Prof. I. REMSEN. New Edition. Fcap. 8vo, 2s. 6d.

A JUNIOR COURSE of PRACTICAL

CHEMISTRY. By FRANCIS JONES, F.R.S.E., F.C.S. With a Preface by Sir H. E. Roscoe, F.R.S. Eighth Edition. Globe 8vo, 2s. 6d.

AN ELEMENTARY TEXT-BOOK

OF CHEMISTRY. By Prof. W. G. MIXTER. Second Edition. Crown 8vo, 7s. 6d.

THE OWENS COLLEGE COURSE

OF PRACTICAL ORGANIC CHEMISTRY. By J. B. COHEN, Ph.D. Fcap. 8vo, 2s. 6d.

EXPERIMENTAL PROOFS of CHE-

MICAL THEORY for BEGINNERS. By WILLIAM RAMSAY, Ph.D., F.R.S. Second Edition. Pott 8vo, 2s. 6d.

THE GASES of the ATMOSPHERE.

By WILLIAM RAMSAY, F.R.S. Extra Crown 8vo, 6s. net.

THE ELEMENTS of ELECTRO-

CHEMISTRY. By Professor MAX LE BLANC. Translated by W. R. WHITNEY. Globe 8vo, 6s.

A DICTIONARY of CHEMICAL

SOLUBILITIES, INORGANIC. By A. M. COMEY, Ph.D. Demy 8vo, 15s. net.

ANALYTICAL CHEMISTRY. By

A. MENSCHUTKIN. Translated from the third German Edition, under the supervision of the Author, by JAMES LOCKE. Medium 8vo, 17s. net.

ESSAYS in HISTORICAL CHEMIS-

TRY. By T. E. THORPE, F.R.S. Crown 8vo, 8s. 6d. net.

INTRODUCTION TO PHYSICAL

CHEMISTRY. By JAMES WALKER, D.Sc., Ph.D., Professor of Chemistry in University College, Dundee. 8vo, 10s. net.

OUTLINES of GENERAL CHE-

MISTRY. By Prof. WILHELM OSTWALD. Translated by J. WALKER, D.Sc., Ph.D. 8vo, 10s. net.

The SCIENTIFIC FOUNDATIONS

OF ANALYTICAL CHEMISTRY TREATED IN AN ELEMENTARY MANNER. By WILHELM OSTWALD, Ph.D. Translated by GEORGE MACGOWAN, Ph.D. Crown 8vo, 5s. net.

MANUAL of PHYSICO-CHEMICAL

MEASUREMENTS. By Prof. W. OSTWALD. Translated by JAMES WALKER, D.Sc., Ph.D. Illustrated. 8vo, 7s. net.

LABORATORY MANUAL EX-

PERIMENTS TO ILLUSTRATE THE ELEMENTARY PRINCIPLES OF CHEMISTRY. By H. W. HILLYER, Ph.D. Medium 8vo, 4s. net.

A LABORATORY MANUAL OF

ORGANIC CHEMISTRY. By Dr. LASSAR-COHN. Translated by A. SMITH, B.Sc., Ph.D. Crown 8vo, 8s. 6d.

CHEMICAL ARITHMETIC. With

1200 Problems. By S. LUPTON, M.A. 2nd Edition, revised. Fcap. 8vo, 4s. 6d.

The ARITHMETIC of CHEMISTRY.

By JOHN WADDELL, B.Sc., Ph.D. Globe 8vo, 4s. net.

NOTES on OBSERVATIONS. Being

an Outline of the Methods used for Determining the Meaning and Value of Quantitative Observations and Experiments in Physics and Chemistry, and for reducing the results obtained. By SYDNEY LUPTON, M.A. Crown 8vo, 3s. 6d.

CHEMICAL ANALYSIS OF OILS,

FATS, WAXES, AND OF THE COMMERCIAL PRODUCTS DERIVED THEREFROM. Founded on BENEDIKT'S Second Edition of "Analyse der Fette." By J. LEWKOWITSCH, F.I.C., F.C.S. Second thoroughly revised and enlarged edition. Demy 8vo, 25s. net.

SYSTEMATIC SURVEY OF THE

ORGANIC COLOURING MATTERS. By Dr. G. SCHULTZ and P. JULIUS. Translated and Edited by A. G. GREEN, F.I.C., F.C.S. Royal 8vo, 21s. net.

A HISTORY of CHEMISTRY from

EARLIEST TIMES TO THE PRESENT DAY. By Prof. ERNST VON MEYER, Ph.D. Translated by GEORGE M'GOWAN, Ph.D. Second English Edition. 8vo, 15s. net.

CO-OPERATIVE WORLD TRAVEL

Organised by HENRY S. LUNN, M.D., F.R.G.S.
W. HOLDSWORTH LUNN & CONNOP F.S. PEROWNE.

A Cruise to NAPLES, ANCONA, VENICE, and the
ISTRIAN and DALMATIAN COASTS,

FOR BOSNIA, HERZEGOVINA, and MONTENEGRO.
(Return Ticket to MARSEILLES included.)

A TWENTY-ONE DAYS' CRUISE FOR £24 3s. and UPWARDS.
S.V. ARGONAUT. Tonnage, 3254; h.-p., 4000.

£10 10s. and £13 13s. TOURS TO ROME.
Extensions to NAPLES, FLORENCE, VENICE,
and the ITALIAN LAKES.

Full particulars from the Secretary, 5 Endsleigh Gardens,
Euston, London, N.W.

PHENIX FIRE OFFICE,

9 LOMBARD ST., E.C., and 57 CHARING CROSS, S.W.

ESTABLISHED 1782.

MODERATE RATES. ABSOLUTE SECURITY.
ELECTRIC LIGHTING RULES SUPPLIED.

LIBERAL LOSS SETTLEMENTS.

PROMPT PAYMENT OF CLAIMS.

FRANCIS B. MACDONALD, SECRETARY.

LOSSES PAID OVER £22,000,000.

ESTABLISHED 1851.

BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

INVESTED FUNDS

£10,000,000.

The BIRKBECK ALMANACK, with full particulars, post free.

FRANCIS RAVENSCROFT, Manager.

**LIVING SPECIMENS FOR
THE MICROSCOPE.**

Volvox, Spirogyra, Desmids, Diatoms, Amoeba, Arcella, Actinosphaerium,
Vorticella, Stentor, Hydra, Floscularia, Stephanoceros, Melicerta, and many
other Specimens of Pond Life. Price 12. per Tube, Post Free. Helix
pomatia, Astacus, Amphioxus, Rana, Anodon, &c., for Dissection purposes.

THOMAS BOLTON,

25 BALSALL HEATH ROAD, BIRMINGHAM.

**MARINE BIOLOGICAL ASSOCIATION
OF THE UNITED KINGDOM.**

THE LABORATORY, PLYMOUTH.

The following animals can always be supplied, either living
or preserved by the best methods:—

Sycon; Clava, Obelia, Sertularia; Actinia, Tealia, Caryophyllia, Alcyon-
ium; Hormiphora (preserved); Leptoplana; Lineus, Amphiporus; Nereis,
Aphrodite, Arenicola, Lanice, Terebella; Lepas, Balanus, Gammarus,
Ligia, Mysid, Nebalia, Carcinus; Patella, Buccinum, Eledone, Pectenus,
Bugula, Crisia, Pedicellina, Holothuria, Asterias, Echinus; Ascidia, Salpa
(preserved), Scyllium, Raja, &c., &c.

For price and more detailed lists apply to
Biological Laboratory, Plymouth.

THE DIRECTOR.

NOTICE.—Advertisements and business letters for NATURE should be addressed to the Publishers; Editorial
communications to the Editor. The telegraphic address of NATURE is "PHUSIS," LONDON.

SUBSCRIPTIONS TO "NATURE."

	£	s.	d.
Yearly	1	8	0
Half-yearly	0	14	6
Quarterly	0	7	6
TO ALL PLACES ABROAD:—			
Yearly	1	10	6
Half-yearly	0	15	6
Quarterly	0	8	0

Cheques and Money Orders payable to MACMILLAN & CO., Limited.

OFFICE: ST. MARTIN'S STREET, LONDON, W.C.

WATKINS & DONCASTER,

NATURALISTS,

AND MANUFACTURERS OF

CABINETS AND APPARATUS

FOR ENTOMOLOGY, BIRDS' EGGS AND SKINS, AND ALL
BRANCHES OF NATURAL HISTORY.

SPECIAL SHOW-ROOM FOR CABINETS.

Our new Catalogue for 1900 (96 pp.) is now ready, and may
be had Post free on application.

N.B.—For Excellence and Superiority of Cabinets and
Apparatus, references are permitted to distinguished
patrons, Museums, Colleges, &c.

A LARGE STOCK OF INSECTS AND BIRDS' EGGS.

Birds, Mammals, &c., Preserved and Mounted by First-class Workmen
with true natural surroundings.

All Books and Publications on Natural History supplied.

36 STRAND, LONDON, W.C.

(Five Doors from Charing Cross.)

MINERALS, ROCKS & FOSSILS.

COLLECTIONS FOR STUDENTS.

Carefully labelled and arranged in Boxes with Card Trays.

50 Minerals, 12/6; 100 do., 21/-; 200 do., 42/-.

Rocks and Fossils at similar prices.

300 Minerals in Cabinet, £4 4/-; 400 do., £5 12s. 6d.

Catalogues Post Free.

THOMAS D. RUSSELL,

78 NEWGATE STREET, LONDON, E.C.

MINERALS AND PRECIOUS STONES.

Mr. HENSON has now on hand a Fine Series of interesting Sapphires,
also Topazes, Gold, and Barytes in Large Crystals of various Colours.
Large and perfectly clear Rock Crystal Balls, precious Opal Cameos,
Fluor Spar, Agate, Jasper, and other Stones cut for ornamental purposes.

LESSONS GIVEN.

SAMUEL HENSON,

97 REGENT STREET, LONDON, W.

ESTABLISHED 1840.

PHYSIOGRAPHY and GEOLOGY.

COLLECTIONS & MICROSCOPIC SLIDES,

As advised by Science and Art Directory, arranged by

JAMES R. GREGORY & CO.,

Mineralogists, &c.

To Science and Art Department, British, Indian and Colonial
Museums, &c.

NOVELTIES and RARE GEMS and PRECIOUS
STONES.

Mineral Specimens for Museums, and Collectors, and all purposes.
Rock Specimens and Microscopic Sections of Rocks and Minerals,
cut to order.

NEW AND VALUABLE MINERAL SPECIMENS CONSTANTLY
ARRIVING.

Stores & Offices: 1 Kelso Place, KENSINGTON, W.

NEW CATALOGUES AND LISTS FREE.

CHARGES FOR ADVERTISEMENTS.

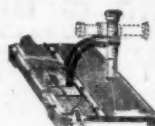
	£	s.	d.
*Three Lines in Column	0	2	6
Per Line after	0	0	9
One Eighth Page, or Quarter Column	0	18	6
Quarter Page, or Half a Column	1	15	0
Half a Page, or a Column	3	5	0
Whole Page	6	6	0

*The first line being in heavy type is charged for as Two Lines.

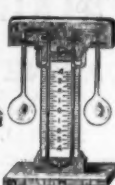


HARRIS' ORIGINAL PATTERN ATWOOD MACHINE.
7012A, Accurate and Reliable, 8 to 9 feet high, Graduated, £3 15s.

HARRIS' SPECIALITIES.—CATALOGUES UPON APPLICATION.



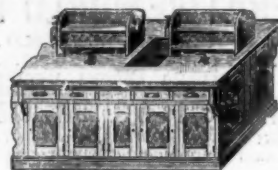
Vernier Microscope,
196A, £2 2s. 6d.



Registered Differential Thermometer, 6287A, 15s. 6d.



New Cathetometer, 187C, £5 12s. 6d.



Complete Laboratory Furnishing.



Drawing Model.

ESTIMATES FREE.

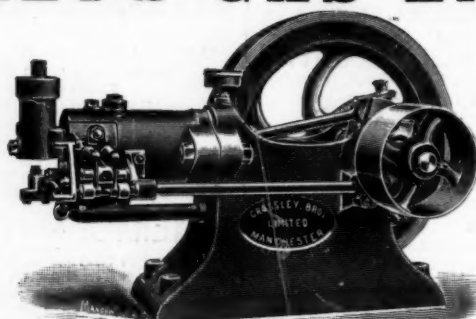
Telegraphic Address :
"Science," Birmingham.
Telephone No. 10.

PHILIP HARRIS & Co., Ltd.,

COMPLETE LABORATORY FURNISHERS, BIRMINGHAM.

CROSSLEY'S GAS ENGINES.

RECENTLY
REMODELLED.



GREAT
REDUCTION
IN
GAS
CONSUMED.

CROSSLEY BROS., LTD., OPENSRAW, MANCHESTER.

WATSON'S NEW MICROSCOPES AND APPARATUS.



WATSON'S HOLOSCOPIC EYEPIECES, for use with either APOCHROMATIC or ACHROMATIC OBJECTIVES, an adjustment being provided to the special lenses employed, for altering the correction. There is no sacrifice of efficiency, the performance being equal to the most expensive Compensating or Huyghenian Oculars.

Magnifying Powers—

6 in. tube length, 5, 7, 10, and 14 diameters.
10 in. " 7, 10, 14, and 20 "

PRICE, in Student's Size and Pattern, either power, 17/6 each.

For Full Particulars see Supplemental List, Post Free.

WATSON'S PARACHROMATIC OIL IMMERSION CONDENSER.

Total aperture, 1.20; applanatic aperture exceeds 1.25. Undoubtedly the finest Condenser obtainable for high-power work. Optical part only ... £5 0 0

Completely mounted with Iris Diaphragm and Set of Stops ... £8 10 0

WATSON'S "SCHOOL" MICROSCOPE, New Model, complete with 1 in. Objective, in Case ... £3 3 0

WATSON'S "ROYAL" MICROSCOPE. A new model high-class instrument.

WATSON'S "FRAM" MICROSCOPE. A highest-class instrument at a very moderate cost.

BACTERIOLOGICAL APPARATUS. MICROTOMES. Apparatus for FIELD BOTANY and FIELD GEOLOGY. METAMORPHOSES and DISSECTED PREPARATIONS. BOTANICAL and PHYSIOLOGICAL MODELS.

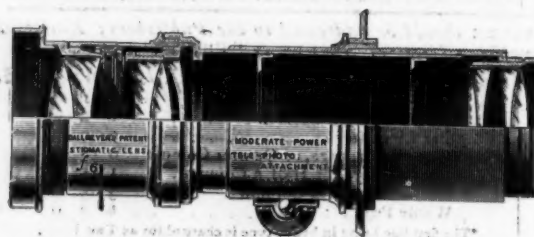
For Particulars of all the above, see Watson's New Supplemental List to Catalogue No. 3, Post Free on application.

Watson's Catalogue (No. 3) is a Classified List representing a Stock of 40,000 first-class Micro-Slides, Post free on application.

W. WATSON & SONS (Established 1837), Opticians to H.M. Government.

313 HIGH HOLBORN, LONDON, W.C. New Branch Now Open: 16 FORREST ROAD, EDINBURGH. And at 78 Swanston Street, Melbourne, Australia. Awarded 39 Gold and other Medals at the principal International Exhibitions of the World.

DALLMEYER'S TELE-PHOTO. LENSES & ATTACHMENTS



Enable you to take Photographs of Distant or Inaccessible Subjects of sufficient size to be of practical value.

Indispensable to Geologists, Naturalists, and Architects.

Price from £3 15s.

Prices and Particulars on application. Estimates and advice free.

J. H. DALLMEYER, Ltd.,

25 Newman Street, London, W.

Stigmatic Lens fitted with Tele-Photo Attachment.

(These Attachments can be fitted to any good Lens.)

Printed by RICHARD CLAY AND SONS, LIMITED, at 7 & 8 Bread Street Hill, Queen Victoria Street, in the City of London and published by MACMILLAN AND CO., LIMITED, at St. Martin's Street, London, W.C., and THE MACMILLAN COMPANY, 66 Fifth Avenue, New York.—THURSDAY, April 19, 1900.



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

No. 1591, VOL. 61]

THURSDAY, APRIL 26, 1900.

[PRICE SIXPENCE.

Registered as a Newspaper at the General Post Office.]

[All Rights are Reserved.

WIRELESS TELEGRAPHY.

The "APPS-NEWTON" INDUCTION COILS have proved far superior to all others in telegraphing long distances without wires.

They were used in the Government Experiments at Penarth and Dover; also by Signor Marconi and the Wireless Telegraph Company in telegraphing to and from the Goodwin Lightship, and across the Channel; at the British Association Meeting at Dover for telegraphing to France; and at the Naval Manœuvres, where a distance of sixty miles was covered, &c.

After prolonged tests the "Apps-Newton" Coils have been adopted by the Wireless Telegraph Company, by the War Office and by the Admiralty; several have been sent to the Front in South Africa, and the ships of the Channel Squadron are now being fitted with them.

PRICES ON APPLICATION.

SOLE MAKERS:

NEWTON & CO.,

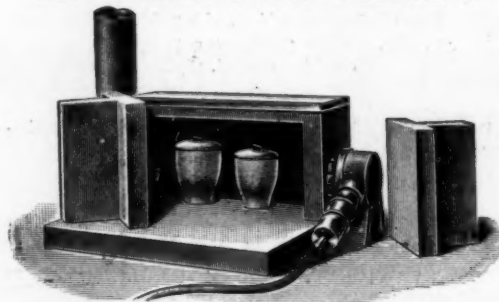
Scientific Instrument Makers to H.M. the Queen
and the Government,

3 FLEET STREET, LONDON, E.C.

A NEW GAS FURNACE

(Holloway's Patent)

FOR CHEMISTS AND ASSAYERS.



PARTS SEPARATE. LESS CRACKING.

All particulars from SOLE MAKERS:

JOHN J. GRIFFIN & SONS, LD.
20-26 SARDINIA STREET, LONDON, W.C.

By the Late Dr. ST. GEORGE MIVART.

THE GROUNDWORK OF SCIENCE.

Large 8vo, Cloth extra, 6s.

"His firm grasp of logical principles, steady insight, and clear reasonableness, eminently fit him for the task of exposing the fallacies of light scepticism, and quibbling cranks of the imagination."—*Tablet*.

"We can do little more, in the limits of newspaper space, than announce, with a cordial welcome, a new and important work by Prof. St. George Mivart. . . . This is strictly a treatise on mental science, and proves once again the philosophic power of a thinker who has done so much as an observer and as a judge of evidence."—*Weekly Register*.

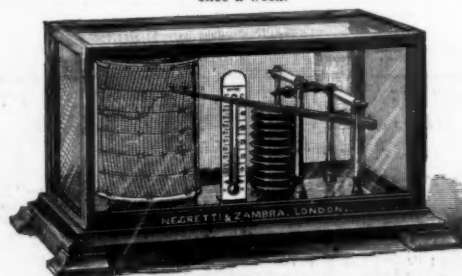
The late Dr. St. George Mivart, in a letter written a few weeks ago, said:—

"My last work, 'The Groundwork of Science,' has undergone no ecclesiastical supervision, my convictions, when I wrote it, being almost fully what they now are."

JOHN MURRAY, ALBEMARLE STREET, W.

NEGRETTI & ZAMBRA'S Self-Registering Barometers, Thermometers and Rain Gauges.

Giving continuous Records on Charts, and only requiring attention once a week.



THE LARGE SIZE BAROGRAPH, £7 10

Accurate Thermometers for all purposes.

Illustrated Price List of Instruments free by post to all parts of the World.

38 HOLBORN VIADUCT, E.C.

BRANCHES—45 CORNHILL, and 122 REGENT STREET.

BEDFORD COLLEGE, LONDON (FOR WOMEN),

YORK PLACE, BAKER STREET, W.
ENTRANCE SCHOLARSHIPS.

The "Henry Tate Scholarship" in Science, annual value £50.
A Pfeiffer Scholarship in Science, annual value £48.
A Reid Scholarship in Arts, annual value £37 10s.
All tenable for three years.

Will be awarded on the results of the Examination to be held at the College on June 26th and 27th. Candidates must be under 19 years of age on the first day of the examination.

For further information apply to the PRINCIPAL.

CHESHIRE COUNTY COUNCIL. AGRICULTURAL AND HORTICULTURAL SCHOOL, HOLMES CHAPEL.

WANTED—a PRINCIPAL for the above School, and to take supervision of the Farm, and the Experimental Work in connection therewith. There are at present 45 Students. Candidates must have experience in the working of a School, and a practical knowledge of Agriculture and Farm Work. Salary, £300 per annum, with Board and Residence. Applications, accompanied by not more than four recent testimonials, to be addressed to the undersigned, on or before May 15 next. Canvassing of Members of the Committee will be deemed a disqualification.

R. P. WARD.

Organising Secretary's Office, Crewe.

UNIVERSITY COLLEGE, LONDON. FACULTY OF MEDICINE.

The Summer Session begins on May 1st. The work is arranged so that a Student may advantageously begin his Medical Curriculum then. Full information may be obtained from either of the undersigned.

H. R. SPENCER, M.D., F.R.C.P.,
Dean of the Faculty.

J. M. HORSBURGH, M.A., Secretary.

SCIENCE AND ART EXAMS.

LONDON AND SOUTH KENSINGTON.

Oral or Correspondence Preparation by SPECIALIST TUTORS.

New and Perfected System of Correspondence Tuition. WORKSHEETS
A SPECIALITY, saving Time and Trouble.

ADDRESS:—

JOHN GIBSON, M.A., 24 CHANCERY LANE,
W.C.

SCIENCE EXAMINATIONS.

For LONDON and other UNIVERSITIES, the
CONJOINT BOARD, &c.

Well-equipped LABORATORIES, DAY AND EVENING. Personal
or Class Tuition.

"R.," 9 Heathcote Street, Gray's Inn Road, W.C.

WANTED.—MINERALOGIST possessing

University training and ability to classify Minerals. Must speak French and English fluently. German or other European language useful. To act as Representative in Paris Exposition, and after as Travelling Mineralogist for leading dealers in specimens. Fair Salary and Advancement. Address

W. M. FOOTE,
Agent for the Foote Mineral Co.,
24 Rue du Champ de Mars, Paris, France.

JOURNAL OF THE INSTITUTION OF ELECTRICAL ENGINEERS.

Edited by W. G. McMILLAN, Secretary.

PART No. 144.

Containing the following papers, with the discussions thereon:—"The Standardisation of Electrical Engineering Plant," by R. PERCY SELLON, Member; "On the Application of Electricity in Medical and Surgical Practice," by H. LEWIS JONES, M.D., Associate; together with a paper on "The Problem of Arc-Lighting from 250-Volt Supply," by W. B. SAYERS, Member; Professor G. F. FITZGERALD's "Inaugural Address as Chairman of the Dublin Local Section," and the following Original Communications: "A Two-Phase Rotary Converter and a Note on the Regulation of Rotary Converters," by Professor E. WILSON, Member; and "The Air-Gap Induction in Continuous Current Dynamos," by C. C. HAWKINS, Member, and R. WIGHTMAN, Associate.

Price 3s. 6d.

E. & F. N. SPON, LIMITED, 125 STRAND, W.C.

C. E. MÜLLER & CO., SCIENTIFIC GLASS BLOWERS

AND
MANUFACTURERS OF
CHEMICAL AND PHYSICAL APPARATUS.
X-Ray Tubes, Argon and Helium Spectrum Tubes,
Special Apparatus for Research, Chemical
Thermometers, &c., &c.

SPECIALITIES:

CHEMICAL THERMOMETERS. GLASS STOPCOCKS.



PATENT DOUBLE SURFACE CONDENSER. MERCURY PUMPS, SPECTRUM TUBES, &c., &c.

Price Lists, with Particulars of above, on application.
List of **BALANCES** also Post Free.

148 HIGH HOLBORN,
LONDON, W.C.

R. FRIEDLÄNDER & SOHN, PUBLISHERS, BERLIN (GERMANY), N.W., CARLSTRASSE 11.

Now Ready.

A. B. MEYER and L. W. WIGLESWORTH. THE BIRDS OF CELEBES AND THE NEIGHBOURING ISLANDS.

2 Volumes in Imperial Quarto.

xxxiii, 130 and 962 pages of Text, with 7 Coloured Maps and
45 Plates, of which 42 (Figures of 77 Species) are
carefully coloured, 1898.

Price £12 net.

Prospectus with Specimen Plate and Reviews sent on applica-
tion.

E. L. TROUESSART.

CATALOGUS MAMMALIUM, TAM VIVENTIUM QUAM FOSSILIIUM.

2 Volumina: xvi et 1469 pg., roy. 8, 1897-99.

Price £3 6s. net.

After receipt of Price, these Works are sent Carriage Free.

BARGAINS IN SCIENTIFIC BOOKS.

GREENE, F.Z.S. (Dr. W. T.).—BIRDS OF THE BRITISH EMPIRE. Many Illustrations, 8vo, Cloth (pub. 7s. 6d.). 2s. 6d.

GORE, F.R.A.S., M.R.I.A., &c. (J. E.).—THE WORLDS OF SPACE. A Series of Popular Articles on Astronomical Subjects. Illustrations, Crown 8vo, Cloth (pub. 7s. 6d.). 1s. 6d.

DAVIS (GEORGE E.).—PRACTICAL MICROSCOPY. Illustrated with 310 Woodcuts and a Coloured Frontispiece. Third and Revised Edition, 8vo, Cloth (pub. 7s. 6d.). 3s. This is the third and enlarged edition, bringing down the subject to the present time; and not only has this been done with regard to English instruments, but the scope of the work has been extended so as to include the apparatus in general use upon the Continent and also in the United States.

MEYRICK (E.).—A HANDBOOK OF BRITISH LEPIDOPTERA. By EDWARD MEYRICK, R.A., F.Z.S., F.E.S., Assistant Master at Marlborough College. Extra Crown 8vo (pub. 10s. 6d. net, Macmillan). 3s.

"This book cannot fail to afford great assistance to the student who desires to recognise and identify his specimens without the necessity of comparing them with named examples. It is without exception the best class-book that has yet appeared for imparting real sound knowledge of structure, evolution, and classification.—*Entomologist's Monthly Magazine*."

KIRBY and HOFFMAN.—THE BEETLE COLLECTOR'S HANDBOOK. By Dr. E. HOFFMAN and Dr. W. E. KIRBY. With 20 Coloured Plates, containing over 500 Coloured Figures. Crown 8vo, Cloth Gilt (pub. 4s. 6d., Sonnenschein). 2s. 9d.

The only complete recent Guide for Beetle-Collecting. The CONTENTS deal with the Structure, Development, Habits, &c., of Beetles, How to Kill Them, and How to Arrange the Collection, followed by Full Accounts of the Several Species, which the 500 Coloured Figures represent. "The plates contain upwards of 500 figures, and those of many of the larger species are excellent. We can recommend this work as one which is likely to induce many to collect."—*Science Gossip*.

Includ Postage, 4d. extra.

H. J. GLAISHER, New and Remainder Bookseller,
57 WIGMORE STREET, LONDON, W.
Catalogues Post Free on application.

Now Ready. 8vo. Price 4s. net.

INORGANIC EVOLUTION AS STUDIED BY SPECTRUM ANALYSIS.

BY

SIR NORMAN LOCKYER, K.C.B., F.R.S.

MACMILLAN AND CO., LTD., LONDON.

ECLIPSE OF THE SUN.

COOK'S SELECT CONDUCTED TOURS

TO NAVALMORAL ALGIERS,

Including
PARIS, BORDEAUX,
BIARRITZ, MADRID, &c.
Inclusive Fare, £30.
By short Sea Route *via*
DOVER and CALAIS, including
PARIS, MARSEILLES,
ALGIERS, BLIDAH,
GORGE OF CHIFFA, &c.
Inclusive Fare, 29 Guineas.

LEAVING LONDON, MONDAY, MAY 21ST.

Including First Class Rail and Steamer Tickets for the Round; First-class Hotel Accommodation; Omnibuses to and from Hotels while with the Conductors; Carriage Excursions; Fees to Hotel and Railway Servants; and Admission Fees at all places of interest visited with the Conductors.

PROGRAMMES FREE ON APPLICATION.

INDEPENDENT TICKETS BY ALL ROUTES.

THOS. COOK & SON,
LUDGATE CIRCUS, LONDON,
AND BRANCH OFFICES.

NEW WORK BY MR. N. C. MACNAMARA.

Now Ready, with 33 Illustrations, Crown 8vo, 6s.

THE ORIGIN AND CHARACTER OF THE BRITISH PEOPLE.

By NOTTIDGE CHARLES MACNAMARA, F.R.C.S.

Author of "Story of an Irish Sept," "History of Asiatic Cholera," &c.

London: SMITH, ELDER & CO., 15 Waterloo Place, S.W.

LATEST PUBLICATIONS OF THE ZOOLOGICAL
SOCIETY OF LONDON.

PROCEEDINGS OF THE ZOOLOGICAL
SOCIETY OF LONDON, 1899. Part IV. Containing Papers read at the Scientific Meetings held in November and December 1899. With 18 Plates. Price to Fellows, 9s.; to the Public, 12s.

To be obtained at the Society's Office (3 Hanover Square, W.), or through any Bookseller.

Second Volume.

A SELECTION OF PHOTOGRAPHS OF STARS, STAR CLUSTERS, AND NEBULÆ,

Together with Information concerning the Methods employed in the Pursuit of
Celestial Photography (Illustrated by 72 Photographs reproduced in Collotype),

By ISAAC ROBERTS, D.Sc., F.R.S.

Now Ready. Royal Quarto. Price 30s., post free.

LONDON: KNOWLEDGE OFFICE, 326 HIGH HOLBORN, W.C.

JAS. SWIFT & SON,

MANUFACTURING OPTICIANS.

SOLELY APPOINTED TO THE A.M. DEPT.
WAR OFFICE, FOR THE SUPPLY
OF MICROSCOPES.



Patent form of Student's Microscope,
fitted with $\frac{2}{3}$ " and $\frac{1}{6}$ " Pan-Aplanatic
Objectives, Iris Diaphragm and Oculars,
in Case, from

£5 5s.

These Instruments we have supplied in
numbers to the following Medical Schools,
viz. St. Mary's, St. Bartholomew's, Guy's,
Middlesex, London, and St. Thomas's.

Seven Gold Medals awarded for excel-
lence of manufacture.

Catalogue on Application.

81, TOTTENHAM COURT ROAD, W.

EVERETT & CO., MECHANICAL ENGINEERS & ELECTRICIANS,

22 CHARTERHOUSE SQUARE, E.C.
MAKERS OF HIGH-GRADE

PHYSICAL & ELECTRICAL APPARATUS.

Apparatus designed and made for Laboratories
and Research Work.

ALL KINDS OF EXPERIMENTAL WORK.

Our List is now ready, and may be had *post free* on application.

See "Notes" in NATURE, March 15, 1900.

Narrow Coil
D'Arsonval Galvo.



C. BAKER,

MICROSCOPE

MANUFACTURER.

CATALOGUE 1899-1900

Post Free to readers of this
Journal. Apply—

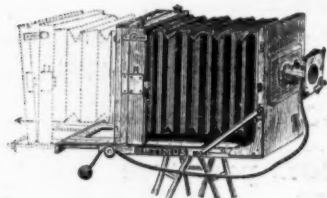
244 HIGH HOLBORN, W.C.

TO SCIENCE LECTURERS. HUGHES' MOTO-PHOTO-SCOPE FOR LIVING PICTURES.

THE MOST PERFECT.

NO SHUTTER, therefore no Flickering. Superb Mechanism.
The Moto-Photo Camera for taking the Pictures. Illustrated Lists, *ed.*
See Mr. HUGHES' PATENT COMBINATION OPTICAL LANTERN,
&c. Miniature Triple Lantern constructed for B. J. MALDEN, Esq.; great
success. New Oxyhydrogen Microscope. Science Lanterns for Class
Demonstration. Magnificent Results. Docwra Triple, Prize Medals
Highest Award. Supplied to the Royal Polytechnic Institution, Dr. H. GRAT-
TAN GUINNESS, Madame ADELINA PATTI, &c., &c. Patent Pamphengo,
Science Lanterns. The Universal Lantern 4-inch Condensers. 4-wick Lamp,
Portrait Combination front Lenses, 18s. 6d., Marvellous value. Science
Lecture Sets. Novelties. The Lantern Kaleidoscope. Cheapest Lantern
Outfits in the World. Grandly Illustrated Catalogue, over 180 choice En-
gravings, 6d.; Postage, 3d. List of 300 Lecture Sets, Science Subjects,
Views, &c., 6d.; Postage, 3d. Pamphlets Free. W. C. HUGHES,
SPECIALIST, Brewster House, 35 Mortimer Road, Kingsland, N.

TRADE
MARK



"OPTIMUS."

TELEGRAPHIC
ADDRESS.

PHOTOGRAPHIC
APPARATUS

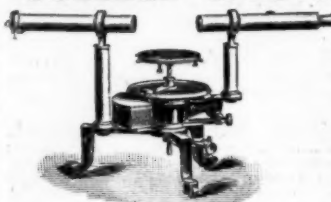
OF BEST WORKMANSHIP
FOR ALL PURPOSES.

Catalogue POST FREE.



PERKEN, SON & CO., LTD., 99, HATTON GARDEN, LONDON.

W. WILSON. COLLEGE SPECTROMETER.



5" Circle, reading to
1 min. Fine adjust-
ment to telescope and
prism table. Rack
motion to telescope;
adjustable slit and
comparison prism to
collimator. Rising
and adjustable prism
table ... £11 10 0

With 6" Circle, reading to 30" ... 14 0 0

Spectrometers made to the highest degree of accuracy

1 BELMONT STREET, CHALK FARM, N.W.

A NEW STEREOSCOPIC BINOCULAR FIELD GLASS OF NEW FORM and CONSTRUCTION.

(English Patents, Nos. 5639 and
7042, 1894.)



Of handy size, with large
field, brilliant definition, perfect
achromatism, and very decided
STEREOSCOPIC effect, and
which, when once adjusted, are
always ready for use.

Prices: £6 to £8.

For NAVAL MEN and DEERSTALKERS, &c. (we have made
larger sizes for NIGHT and DAY USE, admitting more light, but
of somewhat greater weight). Prices: Night, £10; Day, £11.

Illustrated Price List free.

CARL ZEISS (of JENA),

29 MARGARET STREET, REGENT STREET, LONDON, W.

For Photography, Unsurpassed for fine definition.

COOKE LENSES

TAYLOR, TAYLOR, & HOBSON,
Stoughton Street Works, Leicester;
and 18 Berners Street, London, W.



COSSOR,

87

FARRINGDON RD.,
E.C.

Original Maker of "X" RAY TUBES in England.

FOCUS TUBES giving finest possible definition. IMPROVED TUBE
HOLDERS, with arrangement for securing wires to avoid perforation of tube.
All kinds of "X" Ray Apparatus, Mercury Pumps, Screens, Spark
Gaps, &c. Applications for Price Lists invited.

Sale by Auction.

TUESDAY NEXT, MAY 1.

Collections of British and Foreign Lepidoptera and Coleoptera, also in Papers, Heads and Horns of Animals, Animal Skins, Bird Skins, Minerals, Books, &c.

MR. J. C. STEVENS will Sell the above by Auction at his Great Rooms, 38 King Street, Covent Garden, on Tuesday next, May 1, at half-past 12 precisely. On view day prior, from 10 till 4, and morning of Sale. Catalogues had on application, post-free.

WATKINS & DONCASTER,NATURALISTS,
AND MANUFACTURERS OF**CABINETS AND APPARATUS**FOR ENTOMOLOGY, BIRDS' EGGS AND SKINS, AND ALL
BRANCHES OF NATURAL HISTORY.**SPECIAL SHOW-ROOM FOR CABINETS.**

Our new Catalogue for 1900 (98 pp.) is now ready, and may be had Post Free on application.

N.B.—For Excellence and Superiority of Cabinets and Apparatus, references are permitted to distinguished patrons, Museums, Colleges, &c.

A LARGE STOCK OF INSECTS AND BIRDS' EGGS.

Birds, Mammals, &c., Preserved and Mounted by First-class Workmen with true natural surroundings.

All Books and Publications on Natural History supplied.

36 STRAND, LONDON, W.C.

(Five Doors from Charing Cross.)

MINERALS, ROCKS & FOSSILS.

COLLECTIONS FOR STUDENTS.

Carefully labelled and arranged in Boxes with Card Trays.

50 Minerals, 12/6; 100 do., 21/-; 200 do., 42/-.

Rocks and Fossils at similar prices.

300 Minerals in Cabinet, £4 4s.; 400 do., £5 12s. 6d.

Catalogues Post Free.

THOMAS D. RUSSELL,

78 NEWGATE STREET, LONDON, E.C.

PHYSIOGRAPHY and GEOLOGY.**COLLECTIONS & MICROSCOPIC SLIDES,**

As advised by Science and Art Directory, arranged by

JAMES R. GREGORY & CO.,
Mineralogists, &c.

To Science and Art Department, British, Indian and Colonial
Museums, &c.

**NOVELTIES and RARE GEMS and PRECIOUS
STONES.**

Mineral Specimens for Museums, and Collectors, and all purposes.
Rock Specimens and Microscopic Sections of Rocks and Minerals
cut to order.

NEW AND VALUABLE MINERAL SPECIMENS CONSTANTLY
ARRIVING.

Stores & Offices: 1 Kelso Place, KENSINGTON, W.
NEW CATALOGUES AND LISTS FREE.

**LIVING SPECIMENS FOR
THE MICROSCOPE.**

Volvox, Spirogyra, Desmids, Diatoms, Amoeba, Arcella, Actinosphaerium,
Vorticella, Stentor, Hydra, Floscularia, Stephanoceros, Melicerta, and many
other Specimens of Pond Life. Price 1s. per Tube, Post Free. Helix
pomatia, Astacus, Amphioxus, Rana, Anodon, &c., for Dissection purposes.

THOMAS BOLTON,

25 BALSALL HEATH ROAD, BIRMINGHAM.

**MARINE BIOLOGICAL ASSOCIATION
OF THE UNITED KINGDOM.****THE LABORATORY, PLYMOUTH.**

The following animals can always be supplied, either living
or preserved by the best methods:—

Sycon; Clava, Obelia, Sertularia; Actinia, Tealia, Caryophyllia, Alcyo-
onium; Hormiphora (preserved); Leptoplana; Lineus, Amphiporus; Nereis,
Aphrodite, Arenicola, Lanice, Teredobia; Lepas, Balanus, Gammarus,
Ligia Mysis, Nebalia, Carcinus; Patella, Buccinum, Eledone, Pectens
Bugula, Crisia, Pedicellina, Holothuria, Asterias, Echinus; Ascidia, Salpa
(preserved), Scyllium, Raia, &c., &c.

For prices and more detailed lists apply to
Biological Laboratory, Plymouth.

THE DIRECTOR.

J. & A. CHURCHILL'S LIST.**THE NEW ALGEBRA.****ELEMENTARY ALGEBRA (TO QUAD-**

RATICS). By C. H. FRENCH, M.A., and G. OSBORN, M.A.,
Mathematical Masters at the Leys School, Cambridge, formerly Scholars
of Emmanuel College, Cambridge. Crown 8vo, 3s. 6d.; or with
Answers, 4s. 6d.

"More complete, and on the whole more helpful to a beginner, than any
with which we are acquainted."—*Practical Teacher*.

"Wonderfully clear and simple."—*Journal of Education*.

"Always correct."—*Academy*.

ELEMENTARY PRACTICAL CHEMIS-

TRY AND QUALITATIVE ANALYSIS. By Professors CLOWES
and COLEMAN. Third Edition, with 68 Engravings, post 8vo,
3s. 6d.

INTRODUCTION TO QUANTITATIVE

ANALYSIS. By Professors CLOWES and COLEMAN. With 62
Engravings, post 8vo, 4s. 6d.

PRACTICAL CHEMISTRY and QUALI-

TATIVE ANALYSIS. By Professor CLOWES. Seventh Edition,
with 101 Engravings, post 8vo, 8s. 6d.

QUANTITATIVE ANALYSIS. By Pro-

fessors CLOWES and COLEMAN. Fourth Edition, with 117 En-
gravings, post 8vo, 10s.

A HANDBOOK OF PHYSICS AND

CHEMISTRY, adapted to the Requirements of the First Examination
of the Conjoint Board of the Royal Colleges of Physicians and Surgeons,
and also for General Use. By HERBERT E. CORBIN, B.Sc.Lond.,
and ARCHIBALD M. STEWART, B.Sc.Lond. With 120 Illustrations.
Crown 8vo, 6s. 6d.

"An excellent course of physics and chemistry. . . . We can strongly
recommend it."—*University Correspondent*.

PRACTICAL PHYSIOLOGY, including

HISTOLOGY, CHEMICAL and EXPERIMENTAL PHYSIO-
LOGY. By DE BURGH BURCH, M.D., F.R.S.E., Professor of
Physiology in the Yorkshire College of the Victoria University;
Additional Examiner in Edinburgh University. With 62 Illustrations.
Crown 8vo, 6s. 6d.

A MANUAL OF BOTANY. By J. Reynolds

GREEN, Sc.D., F.R.S., Professor of Botany to the Pharmaceutical
Society; Examiner in Botany to the University of London and the
Victoria University. In Two Vols., with nearly 1200 Illustrations.

Vol. I. MORPHOLOGY AND ANATOMY. Second Edition. 7s. 6d.
Vol. II. CLASSIFICATION AND PHYSIOLOGY. 10s.

**THE QUARTERLY JOURNAL OF
MICROSCOPICAL SCIENCE.**

Edited by E. RAY LANKESTER, M.A., LL.D., F.R.S.,
with the co-operation of ADAM SEDGWICK, M.A.,
F.R.S., W. F. R. WELDON, M.A., F.R.S., and SYDNEY
J. HICKSON, M.A., F.R.S.

Contents of No. 170 (April), with Ten Plates, Price 10s.

On the Reaction of *Daphnia magna* (Straus) to certain Changes
in its Environment. By ERNEST WARREN, D.Sc., Uni-
versity College, London.

A Revision of the Genus *Steganoporella*. By SIDNEY F.
HARMER, Sc.D., F.R.S., Fellow of King's College, Cam-
bridge; Superintendent of the University Museum of
Zoology.

On a New Histriobdellid. By WILLIAM A. HASWELL, M.A.,
D.Sc., F.R.S., Challis Professor of Biology, University of
Sydney.

On Spongioporphylin: the Pigment of *Suberites Wilsoni*. By
C. A. MACMUNN, M.A., M.D.

Further Remarks on the Development of Amphioxus. By
E. W. MACBRIDE, M.A., D.Sc.(Lond.), Professor of
Zoology in McGill University, Montreal.

Quelques Observations sur les Onychophores (Peripatus) de la
Collection du Musée Britannique. Par M. E. L. BOUVIER,
Professeur au Muséum d'histoire naturelle de Paris.

On the Diplochora. III. The Early Development and
Anatomy of Phoronis Buskii, McL. By ARTHUR T.
MASTERMAN, M.A.(Cantab.), D.Sc.(Lond. and St. A.),
Lecturer on Zoology in the New Medical School, Edinburgh.

London: J. & A. CHURCHILL, 7 GREAT MARLBOROUGH ST.

A. AND C. BLACK'S LIST.

A TREATISE ON ZOOLOGY.

By E. RAY LANKESTER, M.A., LL.D., F.R.S., Hon. Fellow of Exeter College, Oxford; Director of the Natural History Departments of the British Museum; Fullerian Professor of Physiology and Comparative Anatomy in the Royal Institution of London. Profusely Illustrated. To be completed in Ten Parts. NOW READY. Part III. THE ECHINODERMA. By F. A. BATHER, M.A., assisted by J. W. GREGORY, D.Sc., and E. S. GOODRICH, M.A. Demy 8vo, paper covers, price 12s. 6d net; cloth, price 15s. net.

"It is marked by three characteristics, which indeed may be regarded as now indispensable to any scientific work of value—perfect lucidity in the illustrations, which are numerous, and, of course, specially drawn by, or under the direction of, the author; a careful exposition of the historical development of life-forms; and complete bibliographies on each branch of the subject."—*Literature*.

NOW READY. Demy 8vo, cloth, price 12s. 6d. net.

SEXUAL DIMORPHISM IN THE ANIMAL KINGDOM. A Theory of the Evolution of Secondary Sexual Characters. By J. T. CUNNINGHAM, M.A. Containing 32 Illustrations.

"Mr. Cunningham has elaborated a theory of evolution in answer to the problem: What are the causes which have produced the three kinds of structural difference in animals? He supports his theory by facts and illustrations drawn mainly from the works of others. A book of distinct scientific importance. The present volume is well printed and profusely illustrated with carefully executed figures."—*The Outlook*.

NOW READY. Crown 8vo, cloth, price 3s. 6d.

INTRODUCTION TO STRUCTURAL BOTANY. Part II. Flowerless Plants. Third Edition. By D. H. SCOTT, M.A., Ph.D., F.R.S., Honorary Keeper of the Jodrell Laboratory, Royal Gardens, Kew.

"It stands out from the ever-increasing crowd of guides, text-books, and manuals, in virtue not only of originality of design, but also of the fact that the subjects treated have been specially investigated for the purpose of the book, so that we have not the mere compilation of a book-man, but an account based on the results of the author's own observation."—*Natural Science*.

NOW READY. Post 8vo, cloth, price 12s. 6d.

ALGEBRA. An Elementary Text-book for the Higher Classes of Secondary Schools and Colleges. Part II. Second Edition. By Prof. GEORGE CHRYSTAL, M.A., LL.D.

"The merits of the work are so well known that it is unnecessary to do more than announce the publication of the new edition."—*Nature*.

NOW READY. Demy 8vo, cloth, price 7s. 6d. net.

THE GRAMMAR OF SCIENCE.

By KARL PEARSON, M.A., F.R.S., Professor of Applied Mathematics and Mechanics in University College, London. Second Edition, thoroughly Revised and much Enlarged. Contains Two entirely New Chapters on Natural Selection and Heredity, embracing a Popular Account of Prof. Pearson's own more recent work in this direction. Containing 33 Illustrations in the Text.

"There is a peculiar opportuneness about the appearance of a new edition of this clear exposition of the scientific method and the claims of science to be regarded as the educational instrument, *par excellence*, for a training in citizenship. . . . We have been again and again impressed, in examining 'The Grammar,' with the remarkable lucidity of Prof. Pearson's explanations."—*Knowledge*.

NOW READY. Demy 8vo, cloth, price 10s. 6d.

TEMPERATE CHILE: a PROGRESSIVE SPAIN. By W. ANDERSON SMITH, formerly Special Commissioner to the Chilean Government to Report on their Rivers.

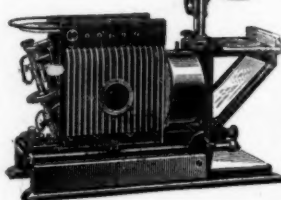
"The book is both charming and valuable."—*Nature*.

A. AND C. BLACK, SOHO SQUARE, LONDON.

Medals and Highest Awards at all Great Exhibitions.

ROSS'

ESTD. 1830.



ROSS' PATENT NEW MODEL PRISMATIC BINOCULAR GLASS.

"The power and field of a Telescope in the compass of an Opera Glass."

Combining Extreme Portability with High Power, Perfect Mechanical Construction, and Exquisite Definition.

NEW SERIES SCIENCE LANTERNS

FOR SCHOOLS, COLLEGES, & PRIVATE EXHIBITIONS.

PHOTOGRAPHIC LENSES AND CAMERAS.

MICROSCOPES, TELESCOPES, FIELD GLASSES, &c., &c.



	Magnification.	Binocular.
6 times	...	£8 0 0
8 "	...	8 0 0
10 "	...	10 0 0
12 "	...	10 0 0

ROSS, Ltd., Manufacturing Opticians,

111 NEW BOND STREET, LONDON, W.,
And 31 COCKSPUR STREET, CHARING CROSS, S.W.

IMPROVED D'ARSONVAL GALVANOMETERS.

PRICES

£10-0-0

AND

£4-10-0

LIBERAL DISCOUNTS.

Most SENSITIVE for DEFLECTIVE, ZERO, or BALLISTIC WORK.



Write for Price List and Particulars of Potentiometers, Galvanometers, Electrical Thermometers, Experimental Direct and Alternating Current Sets, &c., to

CROMPTON & CO., LD.,

Laboratory { "THRIPLANDS," } LONDON, W.
KENSINGTON COURT,

SCOTTISH PROVIDENT INSTITUTION.

HEAD OFFICE: 6 St. Andrew Square, EDINBURGH.

MUTUAL ASSURANCE with MODERATE PREMIUMS.

More than one half of the Members who died during the Septennial period were entitled to Bonuses which, notwithstanding that the premiums do not as a rule exceed the non-profit rates of other Offices, were on the average equal to an Addition of about 50 per cent. to the Policies which participated.

The SURPLUS at last Division was £1,423,000.

Examples of Premium for £100 at Death, with Profits.

AGE.	30*	35	40	45	50	55
DURING LIFE,	£2 1 6	£2 6 10	£2 14 9	£3 5 9	£4 1 7	£5 1 11
25 PAYMENTS,	2 13 0	2 17 9	3 4 6	3 14 0	4 8 7	5 6 11
15 PAYMENTS,	3 12 1	3 18 0	4 5 8	4 16 2	5 11 8	6 9 11

* A person of 30 may secure £1000 at death by a yearly payment during life, of £20 15s., which would in many Offices secure (with profits) £800 only. Or he may secure £1000 by 25 payments of £26 10s., being thus free of payment before age 55.

ACCUMULATED FUNDS, £11,000,000.

Prospectus, with full information, on application.

LONDON OFFICE: 17 KING WILLIAM STREET, E.C.

J. MUIR LEITCH, Secretary.

E. LEYBOLD'S NACHFOLGER,
SCIENTIFIC INSTRUMENT
MAKERS,
COLOGNE (GERMANY).



New Catalogue of Physical Apparatus,
containing 3400 numbers and 1200 illustrations,
sent on application.

DUDELL OSCILLOGRAPH.

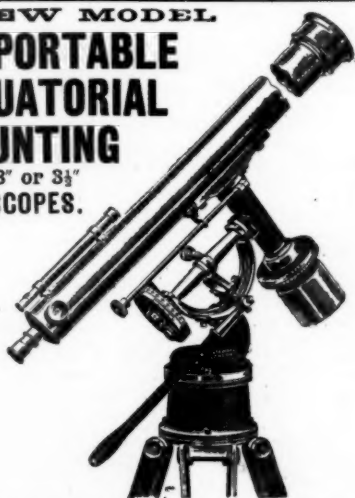
An Invaluable Instrument for
Alternate Current Work.

This Galvanometer has the shortest
periodic time of any Instrument
yet constructed, viz. 0.0001 Second,
is perfectly dead-beat, and the self-
induction is practically nil.

WRITE FOR DESCRIPTIVE PAMPHLET.

SOLE MAKERS—
SCIENTIFIC INSTRUMENT CO.
LIMITED,
CAMBRIDGE.

NEW MODEL
**PORTABLE
EQUATORIAL
MOUNTING**
For 3" or 3½"
TELESCOPES.



Latitude Adjustment, Clamp for Declination Axis, Quick and Slow Motion, in Right Ascension.

EQUATORIAL MOUNTING with Divided Circles and Stand fitted with short Iron Column, Levelling Screws, and Metal Stretcher, £15 15s.; or, complete with 3" Telescope, £25.

ILLUSTRATED CATALOGUE GRATIS.

J. H. STEWARD,
OPTICIAN,
406 STRAND, 457 WEST STRAND,
7 GRACECHURCH STREET, LONDON.

MACMILLAN & CO.'S BOOKS

FOR

STUDENTS OF BOTANY.

PRACTICAL BOTANY for BEGINNERS. By Prof. F. O. BOWER, D.Sc., F.R.S. Globe 8vo. 3s. 6d.

A COURSE of PRACTICAL INSTRUCTION in BOTANY. By F. O. BOWER, D.Sc., F.R.S. Crown 8vo. 10s. 6d.

LABORATORY PRACTICE FOR BEGINNERS IN BOTANY. By W. A. SETCHELL, Ph.D. Fcap. 8vo. 4s. 6d. net.

FIRST LESSONS in PRACTICAL BOTANY. By G. T. BETTANY, M.A., B.Sc., F.L.S. Pott 8vo. 1s.

BOTANY. By Sir J. D. HOOKER, F.R.S. With Illustrations. Pott 8vo. 1s.

The STUDENT'S FLORA of the BRITISH ISLANDS. By Sir J. D. HOOKER, F.R.S. Third Edition. Globe 8vo. 10s. 6d.

LESSONS in ELEMENTARY BOTANY. By DANIEL OLIVER, F.R.S. With numerous Illustrations. Third Edition, Fcap. 8vo. 4s. 6d.

FIRST BOOK of INDIAN BOTANY. By DANIEL OLIVER, F.R.S. With numerous Illustrations. Globe 8vo. 6s. 6d.

A TEXT-BOOK OF BOTANY. By Dr. E. STRASBURGER and Others. Translated by Dr. H. C. PORTER. 8vo. 18s. net.

GRAY'S BOTANICAL TEXT-BOOK (Sixth Edition).

Vol. I. **STRUCTURAL BOTANY**: or Organography on the Basis of Morphology. To which is added The Principles of Taxonomy and Phytography, and a Glossary of Botanical Terms. By ASA GRAY. 8vo. 10s. 6d.

Vol. II. **PHYSIOLOGICAL BOTANY**. I. Outlines of the History of Phenogamous Plants. II. Vegetable Physiology. By G. LINCOLN GOODALE, A.M., M.D. 8vo. 10s. 6d.

The STUDY of the BIOLOGY of FERNS by the COLLODION METHOD. For Advanced and Collegiate Students. By GEORGE F. ATKINSON, Ph.B. 8vo. 8s. 6d. net.

FLOWERS, FRUITS, and LEAVES. By LORD AVEBURY. With numerous Illustrations. Crown 8vo. 4s. 6d. [Nature Series.]

On BRITISH WILD FLOWERS, considered in Relation to Insects. With numerous Illustrations. By LORD AVEBURY. Crown 8vo. 4s. 6d. [Nature Series.]

The COLOURS of FLOWERS, as Illustrated in the British Flora. By GRANT ALLEN. With Illustrations. Crown 8vo. 3s. 6d. [Nature Series.]

THE DAHLIA: Its History and Cultivation. By RICHARD DEAN, F.R.H.S., and Others. Illustrated. Crown 8vo. Price 1s. 6d. (paper, 1s.)

The BOOK of the ROSE. By Rev. A. FOSTER-MELLIAR. Illustrated. Extra Crown 8vo. 8s. 6d. net.

BRITISH FOREST TREES and their SYLVICULTURAL CHARACTERISTICS and TREATMENT. By JOHN NISBET, of the Indian Forest Service. Crown 8vo. 6s. net.

TIMBER and some of its DISEASES. By H. MARSHALL WARD, M.A., F.R.S., F.L.S. With Illustrations. Crown 8vo. 6s. [Nature Series.]

TEXT-BOOK of the DISEASES of TREES. By Professor R. HARTIG. Translated by Dr. W. SOMERVILLE. With a Preface by Prof. H. MARSHALL WARD, F.R.S. With numerous Illustrations. 8vo. 10s. net.

TIMBER and **TIMBER TREES**, Native and Foreign. By THOMAS LASLETT, Timber Inspector to the Admiralty. New Edition. Revised by Prof. H. MARSHALL WARD, F.R.S. Crown 8vo. 8s. 6d.

DISEASES of FIELD and GARDEN CROPS, chiefly such as are caused by Fungi. By W. G. SMITH, F.L.S., M.A.I. With 143 Illustrations. Fcap. 8vo. 4s. 6d.

THE SOIL: ITS NATURE, RELATIONS, AND FUNDAMENTAL PRINCIPLES OF MANAGEMENT. By Prof. F. H. KING. Fcap. 8vo. 3s. net.

IRRIGATION AND **DRAINAGE**. Principles and Practice of their Cultural Phases. By Prof. F. H. KING. Globe 8vo. 6s. [The Rural Science Series.]

THE FARMSTEAD. The Making of the Rural Home and the Lay-out of the Farm. By Prof. J. P. ROBERTS. Illustrated. Globe 8vo. 4s. 6d. net. [The Rural Science Series.]

FARM AND **GARDEN INSECTS**. By WILLIAM SOMERVILLE, D.Cec. (Mon.), D.Sc. (Dun.). With Forty-six Illustrations. Pott 8vo., 1s.

FERTILISERS: The Source, Character, and Composition of Natural, Home-made, and Manufactured Fertilisers, and suggestions as to their use for different crops and conditions. By Prof. EDWARD V. VOORHEES. Globe 8vo. 4s. 6d.

BUSH FRUITS. A Horticultural Monograph of Raspberries, Blackberries, Dewberries, Currants, Gooseberries, and other Shrub-like fruit. By Professor FRED W. CARD. Globe 8vo. 5s. net.

THE SPRAYING OF PLANTS. By E. G. LODEMAN. Globe 8vo. 4s. net.

[The Rural Science Series.]
LECTURES ON THE EVOLUTION OF PLANTS. By Prof. DOUGLAS H. CAMPBELL, Ph.D. Crown 8vo. 4s. 6d. net.

VEGETABLE CULTURE. A Primer for Amateurs, Cottagers, and Allotment Holders. By ALEXANDER DEAN, F.R.H.S. Edited by J. WRIGHT. With Thirty-eight Illustrations. Pott 8vo. 1s.

A PRIMER of PRACTICAL HORTICULTURE. By J. WRIGHT, F.R.H.S. Pott 8vo. 1s.

GARDEN FLOWERS and **PLANTS**. A Primer for Amateurs. By J. WRIGHT, F.R.H.S. With Fifty Illustrations. Pott 8vo. 1s.

GREENHOUSE AND **WINDOW PLANTS**. By CHARLES COLLINS. Edited by J. WRIGHT, F.R.H.S. With Thirty-eight Illustrations. Pott 8vo. 1s.

THE CHEMISTRY of the GARDEN. A Primer for Amateurs and Young Gardeners. By HERBERT H. COUSINS, M.A. With an Introduction by J. WRIGHT, F.R.H.S. Pott 8vo. 1s.

MACMILLAN & CO.'S NEW BOOKS.

1900 ISSUE READY NEXT TUESDAY.

THE

STATESMAN'S YEAR-BOOK.

Statistical and Historical Annual of the States of the World, for the Year 1900.

Edited by J. SCOTT KELTIE, LL.D.,

Secretary to the Royal Geographical Society. Thirty-sixth Annual Publication. Revised after Official Returns.
Crown 8vo. 10s. 6d.

MICRO-ORGANISMS AND FERMENTATION.

By ALFRED JÖRGENSEN,

Director of the Laboratory for the Physiology and Technology of Fermentation at Copenhagen. Translated by ALEX. K. MILLER, Ph.D., F.I.C., and A. E. LENNHOLM. Third Edition, completely Revised. With 83 Illustrations. 8vo. 10s. net.

TEXT-BOOK OF PALÆONTOLOGY.

By KARL A. VON ZITTEL,

Professor of Geology and Palæontology in the University of Munich. Translated and Edited by CHAS. R. EASTMAN, Ph.D., Assistant in Palæontology in the Museum of Comparative Zoology at Harvard. With 1476 Woodcuts. Medium 8vo. 25s. net.
* * This English Edition is revised and enlarged by the Author and Editor in collaboration with numerous Specialists.

SCIENCE GOSSIP.—“The first volume of the most accurate work on fossils that has yet been issued. The drawings, having been well executed as woodcuts, are most excellent, so that we have altogether a remarkable book, and one that every one interested in fossils should make an effort to obtain.”

AN ELEMENTARY COURSE OF PRACTICAL ZOOLOGY.

By the late T. JEFFERY PARKER, D.Sc., F.R.S., Professor of Biology in the University of Otago, Dunedin, New Zealand, and W. NEWTON PARKER, Ph.D., Professor of Zoology at the University College of South Wales and Monmouthshire, in the University of Wales. With 156 Illustrations. Crown 8vo. 10s. 6d.

NATURE.—“Will be welcomed by many as a handy and inexpensive manual of zoology. . . . The illustrations are numerous and useful. . . . The book, it may be safely predicted, will become popular. . . . May be confidently recommended.”

A MANUAL OF ZOOLOGY.

By the late Prof. T. J. PARKER, D.Sc., F.R.S., and Prof. W. A. HASWELL, M.A., D.Sc., F.R.S.
With Three Hundred Illustrations. Crown 8vo. 10s. 6d.

NATURE.—“Contains a great store of information, chosen with judgment and set forth with skill. . . . The book is one which fills a distinct gap in zoological literature, and fills it well.”

THE

PRINCIPLES OF MECHANICS PRESENTED IN A NEW FORM.

By HEINRICH HERTZ,

Late Professor of Physics in the University of Bonn. With an Introduction by H. VON HELMHOLTZ.
Authorised English Translation by D. E. JONES, B.Sc., District Inspector under the Department of Science and Art, &c., and J. T. WALLEY, M.A. 8vo. 10s. net.

ENGINEER.—“A very remarkable book. . . . A book which it is impossible to pass over in silence, fraught as it is with infinite possibilities of the future. It represents the latest work of one of the finest intellects of the century.”

THE PHYSICAL REVIEW.

A JOURNAL OF EXPERIMENTAL AND THEORETICAL PHYSICS.

CONDUCTED BY EDWARD L. NICHOLS, ERNEST MERRITT, AND FREDERICK BEDELL.

No. 3, VOL. X., MARCH, 1900. PRICE 3s. NET.

CONTENTS.—On the Metabolism of Matter in the Living Body. By Edward B. Rosa.—A Dissociation Theory of the Electric Arc. By C. D. Child.—The Effect of Magnetization on the Elasticity of Rods. II. By James S. Stevens.—The Influence of Temperature, Pressure, Used Solutions, and Size of Anodes on the Deposit of Silver Voltameters. By J. F. Merrill.—A Lecture Demonstration in Wave Motion. By Will C. Baker.—An Apparatus for the Determination of the Coefficient of Expansion of Air at Constant Pressure. By C. F. Adams.—On the Change in Length of Soft Iron in an Alternating Magnetic Field. By Louis W. Austin.—New Books.

THE INTERNATIONAL MONTHLY.

A MAGAZINE OF CONTEMPORARY THOUGHT. APRIL, 1900. PRICE 1s. NET.

CONTENTS.—The Institution of Society. By Lindley M. Keasbey, Byrri-Mawr.—Recent Writing on English History. By Edward P. Cheyney. University of Pennsylvania.—The French Drama at the End of the Century. By Brander Matthews, Columbia University.—Comments on the War in South Africa. By Captain E. L. Zalinski, U.S.A. (Retired).—The Neutralization of the Nicaragua Canal. By John R. Procter, Washington.

MACMILLAN AND CO., LIMITED, LONDON.

MACMILLAN & CO.'S BOOKS FOR THE SPRING.

THE GARDEN.

21ST THOUSAND.

ELIZABETH and her GERMAN GARDEN. Extra crown 8vo, 6s.

11TH THOUSAND.

THE SOLITARY SUMMER.

By the same Author. Extra crown 8vo, 6s.

THE BOOK OF THE ROSE.

By Rev. A. FOSTER-MELLIAR, M.A. Illustrated. Extra crown 8vo, 8s. 6d. net.

THE AMATEUR'S PRACTICAL

GARDEN-BOOK: containing the simplest Directions for the Growing of the commonest things about the House and Garden. By C. E. HUNN and L. H. BAILEY. Globe 8vo. 3s. 6d. net. [Just ready.]

GARDEN MAKING. Suggestions for the Utilisation of Home Grounds. By L. H. BAILEY. Globe 8vo, 4s. net.

GARDEN FLOWERS AND PLANTS. A Primer for Amateurs. By J. WRIGHT, F.R.H.S. With 50 Illustrations. Pott 8vo, 1s.

A YEAR IN A LANCASHIRE GARDEN. By HENRY A. BRIGHT. Crown 8vo, 3s. 6d.

THE ENGLISH FLOWER GARDEN. By HENRY A. BRIGHT. With illustrative notes. Crown 8vo, 3s. 6d.

THE COUNTRY-SIDE.

TALES OF THE BIRDS. By W. WARDE FOWLER, M.A. Illustrated. Crown 8vo, 2s. 6d.

A YEAR WITH THE BIRDS. By W. WARDE FOWLER, M.A. With Illustrations by BRYAN HOOK. Third Edition. Enlarged. Crown 8vo, 3s. 6d.

SUMMER STUDIES OF BIRDS AND BOOKS. By W. WARDE FOWLER, M.A. Crown 8vo, 6s.

CURIOSITIES OF NATURAL HISTORY. By FRANCIS T. BUCKLAND. Popular Edition, with a few Illustrations. Each series separately, in small 8vo, price 2s. 6d. as follows: **FIRST SERIES**—Rats, Serpents, Fishes, Frogs, Monkeys, &c. **SECOND SERIES**—Fossils, Bears, Wolves, Cats, Eagles, Hedgehogs, Eels, Herrings, Whales. **THIRD SERIES**—Wild Ducks, Fishing, Lions, Tigers, Foxes, Porpoises. **FOURTH SERIES**—Giants, Mummies, Mermaids, Wonderful People, Salmon, &c.

ROUND THE YEAR. A Series of Short Nature Studies. By Prof. L. C. MIALL, F.R.S. With Illustrations, chiefly by A. R. HAMMOND, F.L.S. Crown 8vo, 5s.

MADAM HOW AND LADY WHY; or First Lessons in Earth-lore for Children. By CHARLES KINGSLEY. Crown 8vo, 3s. 6d. Prize Library Edition, 2s. 6d.

THE COUNTRY-SIDE—(continued.)

AMONG ENGLISH HEDGEROWS. Written and Illustrated by CLIFTON JOHNSON. Extra Crown 8vo, gilt top, 8s. 6d. net.

NATURAL HISTORY AND ANTIQUITIES OF SELBORNE. By GILBERT WHITE, with Notes by FRANK BUCKLAND, a Chapter on Antiquities by Lord SELBORNE, and new Letters. Illustrated. Crown 8vo, 6s.

FORTY YEARS IN A MOORLAND PARISH. Reminiscences and Researches in Danby-in-Cleveland. By the late CANON ATKINSON, D.C.L. With Maps and Illustrations. Extra crown 8vo, 5s. net. Illustrated Edition, 12s. net.

HIGHWAYS & BYWAYS.

NORMANDY. By PERCY DEARMER, M.A. With 150 Illustrations by JOSEPH PENNELL. Extra crown 8vo, 6s. [Just ready.]

DONEGAL, &c. By STEPHEN GWYNN. Illustrated by HUGH THOMSON. Extra crown 8vo, 6s.

YORKSHIRE. By ARTHUR H. NORWAY. Illustrated by JOSEPH PENNELL and HUGH THOMSON. Extra crown 8vo, 6s.

NORTH WALES. By A. G. BRADLEY. Illustrated by HUGH THOMSON and JOSEPH PENNELL. Extra crown 8vo, 6s.

DEVON AND CORNWALL. By A. H. NORWAY. Illustrated by JOSEPH PENNELL and HUGH THOMSON. Extra crown 8vo, 6s.

MR. HISSEY'S ROAD BOOKS.

OVER FEN and WOLD. With Fourteen Full-page (and some smaller) Illustrations. Demy 8vo, 16s.

ON SOUTHERN ENGLISH ROADS. With Illustrations. Demy 8vo, 16s.

THROUGH TEN ENGLISH COUNTIES. With Illustrations. Demy 8vo, 16s.

ACROSS ENGLAND in a DOGCART: from London to St. David's and Back. With Illustrations. Demy 8vo, 16s.

AN OLD-FASHIONED JOURNEY IN ENGLAND AND WALES. Demy 8vo, with Frontispiece, 12s.

A HOLIDAY ON THE ROAD. An Artist's Wanderings in Kent, Sussex, and Surrey. With Illustrations. Demy 8vo, 16s.

MACMILLAN AND CO., LIMITED, LONDON.

ESTABLISHED 1851.
BIRKBECK BANK

30 Southampton Buildings, Chancery Lane, London.

INVESTED FUNDS

£10,000,000.

The BIRKBECK ALMANACK, with full particulars, post free.

FRANCIS RAVENSCROFT, *Manager*.

LETCHER & SONS (formerly Letcher Bros.),

SCIENTIFIC INSTRUMENT MAKERS,

25 TURNPIKE LANE, HORNSEY, N.

BLOWPIPE CABINETS. SPECIALITY: SOCIETY OF ARTS SETS.

PRICE LIST, POST FREE, ON APPLICATION.

THE IRISH NATURALIST.

A Monthly Magazine of Irish Zoology, Botany, and Geology. Price 6d.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD PRAEGER, B.A.

Annual Subscription, 5s. Post Free to any Address.

Dublin: EASON & SON, LTD., 40 Lower Sackville Street (to which Address Subscriptions should be sent).

London: SIMPKIN, MARSHALL, HAMILTON, KENT, & CO., Ltd.

On the 1st of every Month. Greatly Enlarged.

THE JOURNAL OF BOTANY.

BRITISH AND FOREIGN.

Edited by JAMES BRITTEN, F.L.S., British Museum.

CONTENTS:—Original Articles by leading Botanists.—Extracts, and Notices of Books and Memoirs.—Articles in Journals.—Botanical News.—Proceedings of Societies.

The enlargement has made room for many Cryptogamic and other useful and interesting papers which have accrued since the discontinuance of "Grevillea."

Price 1s. 8d. Subscription for One Year, payable in advance, 16s.

London: WEST, NEWMAN, & CO., 54 Hatton Garden, E.C.

PHOENIX FIRE OFFICE,
9 LOMBARD ST., E.C., and 57 CHARING CROSS, S.W.

ESTABLISHED 1782.

MODERATE RATES. ABSOLUTE SECURITY.

ELECTRIC LIGHTING RULES SUPPLIED.

LIBERAL LOSS SETTLEMENTS.

PROMPT PAYMENT OF CLAIMS.

FRANCIS B. MACDONALD, SECRETARY.

LOSSES PAID OVER £22,000,000.

ALBERT EDWARD JAMRACH

(Late CHARLES JAMRACH),

NATURALIST,

180 ST. GEORGE STREET EAST.

Implements of Savage Warfare, Idols, Sacred Masks, Peruvian Pottery
Netsukis China, Lacquers, Gongs, Shells, and other Curios.

THE MOST NUTRITIOUS.

E P P S'S

GRATEFUL—COMFORTING.

C O C O A

BREAKFAST—SUPPER.

HOLLOWAY'S PILLS

CURE

Biliousness, Sick Headache, Indigestion, and
all Internal Complaints.

CAN BE TAKEN BY THE MOST DELICATE.

Holloway's Pills and Ointment may be obtained of
all Medicine Vendors.

SCIENTIFIC WORTHIES.

The following is a list of the Steel Portraits that have appeared in the above Series:—

MICHAEL FARADAY.
THOMAS HENRY HUXLEY.
CHARLES DARWIN.
JOHN TYNDALL.
SIR GEORGE GABRIEL STOKES.
SIR CHARLES LYELL.
SIR CHARLES WHEATSTONE.
SIR WYVILLE THOMSON.
ROBERT WILHELM BUNSEN.
LORD KELVIN.
BARON ADOLF ERIK NOR-
DENSKJÖLD.

HERMANN L. F. HELMHOLTZ.
SIR JOSEPH DALTON HOOKER.
WILLIAM HARVEY.
SIR GEORGE B. AIRY.
J. LOUIS R. AGASSIZ.
JEAN BAPTISTE ANDRÉ DUMAS.
SIR RICHARD OWEN.
JAMES CLERK MAXWELL.
JAMES PRESCOTT JOULE.
WILLIAM SPOTTISWOODE.
ARTHUR CAYLEY.
SIR C. W. SIEMENS.

JOHN COUCH ADAMS.
JAMES JOSEPH SYLVESTER.
DMITRI IVANOWITSH MEN-
DELÉEF.
LOUIS PASTEUR.

SIR ARCHIBALD GEIKIE.
LORD LISTER.
STANISLAO CANNIZZARO.
PROF. VON KÖLLIKER.
PROF. SIMON NEWCOMB.

N.B.—The Portraits of Sir A. Geikie, Lord Lister, Prof. Cannizzaro, Prof. von Kölliker, and Prof. S. Newcomb belong to a New Series and are Photogravures.

Proof impressions of these, printed on India paper, may be had from the Publishers, price 5s. each; or the Series 32 Portraits in a Handsome Portfolio for £8 5s., carriage paid. The Portfolio may be had separately, price 6s.

Cheques and Money Orders payable to MACMILLAN & CO., Limited.

OFFICE OF "NATURE," ST. MARTIN'S STREET, LONDON, W.C.

NOTICE.—Advertisements and business letters for NATURE should be addressed to the Publishers; Editorial communications to the Editor. The telegraphic address of NATURE is "PHUSIS," LONDON.

SUBSCRIPTIONS TO "NATURE."

	£	s.	d.
Yearly	1	8	0
Half-yearly	0	14	6
Quarterly	0	7	6
TO ALL PLACES ABROAD:—			
Yearly	1	10	6
Half-yearly	0	15	6
Quarterly	0	8	0

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
*Three Lines in Column	0	2	6
Per Line after	0	0	9
One Eighth Page, or Quarter Column	0	18	6
Quarter Page, or Half a Column	1	15	0
Half a Page, or a Column	3	5	0
Whole Page	6	6	0

*The first line being in heavy type is charged for as Two Lines.

Cheques and Money Orders payable to MACMILLAN & CO., Limited.

OFFICE: ST. MARTIN'S STREET LONDON, W.C.

The 'N. & G.' Cameras

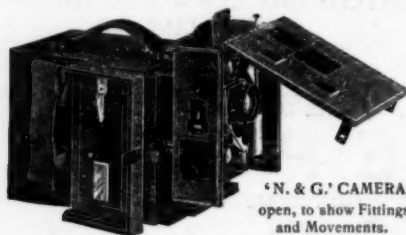
In all sizes up to 7 x 5 in.
For Plates, Cut Films, or Film
in Spools.

For Hand and Tripod.

A Series of High-Class Instruments for Serious Work,
embodying every New Advance in Photography.

Prices from £13 to £50.

Have been in Constant Use for Eight Years in all parts of the World.



'N. & G.' CAMERA,
open, to show Fittings
and Movements.

TRIPOD CAMERAS, SURVEYING CAMERAS, and very Small and
Light POCKET CAMERAS for Travellers and Field Naturalists.

Speciality: COMPLETE OUTFITS for Scientific Expedi-
tions and Special Research.

Catalogues and Estimates of Lenses, Kinematographs, Lanterns, and all
free on application. Photographic Accessories and Materials.

Newman & Guardia, Ltd.

90 & 92 Shaftesbury Avenue, London, W.

TOWNSON & MERGER.

(ESTABLISHED 1798.)

Retail—89 BISHOPSGATE STREET WITHIN, E.C.
Wholesale—34 CAMOMILE STREET, E.C.

Scientific Apparatus Manufacturers and Laboratory
Outfitters to the Home and Colonial Departments of
H.M. Government; Institutions, Colleges, and the
various Industries throughout the World.

Complete Illustrated Catalogue of over 650 pages, with about 3000 illus-
trations, 2s. 6d., or by Post 3s. (Free to Colleges and Schools.)



OPTICAL BENCH, comprising four
Lenses, Candle Socket, Prism, Table, Dia-
phragm, Slit, and Paper Screen, each on Brass
Pillar (adjustable for rotation or height), and
heavy metal Sliding Bases. Mounted on
Polished Oak Frame one metre long, graduated
into centimetres. Price complete, **£3 10s.**



BELL EXPERIMENT, to show that
air is essential to sound. Consisting of Brass
Stopcock (to fit to air pump for exhausting)
and Bell, hermetically sealed to Glass Globe.
Price complete, **10s. 6d.**

WIRELESS TELEGRAPHY.	X RAYS.	BACTERIOLOGICAL RESEARCH.	MECHANICS.	PNEUMATICS.	HYDROSTATICS.	HYDRAULICS.	SOUND, LIGHT, & HEAT.	MAGNETISM AND ELECTRICITY.
-------------------------	---------	------------------------------	------------	-------------	---------------	-------------	--------------------------	-------------------------------

OPPOSITE THE BRITISH MUSEUM.

THACKERAY HOTEL

(TEMPERANCE).

GREAT RUSSELL STREET, LONDON.

THIS newly-erected and commodious Hotel will, it is believed, meet the requirements of those who desire all the conveniences
and advantages of the larger modern licensed hotels at moderate charges. Passenger Lift. Electric Light in all Rooms. Bath-rooms
on every Floor. Spacious Dining, Drawing, Writing, Reading, and Smoking Rooms. All Floors Fireproof. Perfect Sanitation.
Night Porter. Telephone. Bedrooms from 2s. 6d. to 4s. 6d. per night. Full Tariff and Testimonials on application.

Telegraphic Address: "THACKERAY, LONDON."

Proprietor—J. TRUSLOVE.

Also, amalgamated with, and under the same management,

ESMOND HOTEL

(TEMPERANCE).

MONTAGUE STREET, RUSSELL SQUARE.

THIS Hotel, which has been carried on so successfully for the last 13 years, adjoins the British Museum, and is exception-
ally quiet. Bedrooms from 2s. to 3s. 6d. per night. Full Tariff and Testimonials on application.

Telegraphic Address: "TRUSLOVE, LONDON."

Proprietor—J. TRUSLOVE.

TO SCIENTIFIC MEN, NATURALISTS, TRAVELLERS, AND OTHERS.

THE STEREOSCOPIC COMPANY

CAN SPECIALLY
RECOMMEND ANY OF
THE FOLLOWING
HAND CAMERAS



ADDRESS—

106 & 108 RECENT ST., W.,
and 54 Cheapside, E.C.

THE TWIN-LENS ARTIST,

with full size Focussing
Finder, Rapid Euryscope
Lenses, Time and Instanta-
neous Shutter, Rising Front,
Focussing Adjustment,
Double Dark Slides,
Magazine or Cartridge
Roll Holders.

1-p. complete, with £ s.
3 Slides ... 14 14

5 x 4 complete,
with 3 Slides 16 16

1-p. complete, with
3 Slides ... 21 0

THE TWIN-LENS ARTIST,

with
MAGAZINE
for 12 Plates or
24 Films,
&c., &c.,
as described.

1-p. complete... £ s.
15 15

5 x 4 " ... 17 17

1-p. " ... 22 3

THE TWIN-LENS CARLTON,

Carrying 12 Plates
or Films,
and now so well known
as not to
need description.

PRICE:

1-p. complete ... £ s.
12 12

5 x 4 " ... 15 15

1-p. " ... 21 0

PLEASE READ

Extract of Letter from
R. BOWDLER SHARPE,
Esq., LL.D.,
Assist. Keeper Zoological
Dept., British Museum,
March 4, 1898:—

"I consider it one of the
best day's work I ever did
when I bought one of your
Cameras. The ease with
which it is worked, and the
excellent results obtained,
make it a most pleasurable
accompaniment of a summer's
outing."

**FREE LESSONS TO
PURCHASERS.**

7
of
e

ir
-
es
d
n
d
i
ut
ss
(
e.

ces
ms
on.

on-

S.
D

PE,

al

the
did
our
with
the
sed,
able
er's